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FLIGHT OPERATING INSTRUCTIONS FOR MIG-19C AIRCRAFT

I N T R O D U C T I O N

Instructions include the basic information on the MiG-19s aircraft, flight operating data and peculiarities of its operation in normal and emergency conditions.

Instructions contain only basic prescriptions which do must be followed, and it is believed that in all other complicated and emergency circumstances missed by Instructions the pilot will take an independent decision on the spot.

F O R

The MiG-19s fighter is a supersonic jet combat single-seater. M I G -19S A I R C R A F T

The aircraft is powered by two RD-9B engines(with afterburners) coupled inside the fuselage.

The MiG-19s is a cantilever midwing aircraft with sweepback wings and empennage, and controllable stabiliser.

The aircraft is equipped with tricycle type landing gear; the main landing gear wheels are to be retracted into the wings and the nose wheel - into the hull.

The MiG-19s is equipped with all-wheel automatic brake system. The hull of semi-monocoque type has technological and operational joint connections and thus is divided into fore and aft halves. The easily divided hull ensures an access for assembling and disassembling the engine.

The air for the engines is sucked in from the atmosphere by the by-passes which are separated by the bulkhead and run around the pilot's cockpit.

The pilot has an airtight ventilated cockpit which is supplied by the hot or cold air from the engines compressor.

..ir temperature in the cockpit is maintained auto-..tically by the thermoregulator and the distribution cock in a range of 16±4°C.

The cockpit accomodates the ejection seat with the cover for face protection.

The aircraft is equipped with an oxygen set of ..-1(KPO - 1m) type, which contains more complicated and modern altitude equipment for the pilot as compared with all those employed previously. The set provides the pilot with oxygen:

- for a long period of time - when flying in a pressurized cockpit up to 18 000 metres and in an unpressurized cockpit up to 12 000 metres.
- for a short period of time (5-10 minutes) - when ..lying in an unpressurized cockpit up to 18 000 metres;
- when ejecting up to 18 000 metres.

The officials responsible for safe altitude flying (physician, altitude equipment specialist) are to choose and fit the special altitude equipment to every pilot in compliance with ..ethodical Instructions for the oxygen apparatus used in high pressure conditions.

The one-glass cockpit hood consists of the windshield and the movable part which can be jettisoned in case of emergency. To ensure reliable emergency jettisoning of the movable hood, the latter will be pushed up by the air cylinder rods.

The windshield houses the armoured glass and the collector-distributer of the liquid anti-deer system.

The wing has the flaps with sliding axis of rotation and the ailerons with interval aerodynamic compensation; the left aileron has a trim tab. To increase the efficiency of lateral control at speeds corresponding to great M numbers, there are interceptors before the flaps at the wing bottom

linked kinematically with the ailerons.

The upper wing surface carries the aerodynamic fins. The duralumin wing skin is of a stress type. The rigid aileron control system includes on the irreversible scheme the BU-13.. m booster which is fed by the boosters system (the substitute feeding is to be delivered from the main hydraulic system).

The control column is loaded in lateral direction by the spring loading mechanism which is constantly switched into the system.

The horizontal tail unit consists of a movable 55° sweepback fin without elevators.

The rigid system of longitudinal control (of the stabilizer) includes as a main driver on the irreversible scheme the BU-13 mc booster which is fed the boosters system (the substitute feeding is to be delivered from the main hydraulic system).

..s soon as the pressure before the booster drops below 65 + 5 kg/cm^2, the control of the boosters system automatically switches over to the main system.

Besides the substitute control from the main hydraulic system, the stabilizer can be controlled in case of emergency by the APS-4(APS 4md) electric mechanism, the latter being operated by the pilot by shifting the control column with the help of the electric servomechanism.

..s soon as the pressure before the booster drops below 50 + 5 kg/cm^2, the stabilizer control automatically switches over from the hydraulic system to the electric system.

The gear ratio from the control column to the stabilizer varies according to velocity head and flight altitude. Change of the gear ratio is done with the help of the automatic stabilizer control of the APY-2 type.

The control column is loaded in longitudinal direction by the spring loading mechanism through the executive mechanism of the APY-2 automatic stabilizer control, the aerodynamic hinge moment of the stabilizer is not transferred to the control column.

Efforts applied to the control column at its various positions are regulated by the loading mechanism with the help of the electric mechanism of trim effect of the MT-100K type, the latter being controlled by the pilot by moving the button on the control column.

The APY-2 ensures for the pilot practically natural aircraft flying in accordance with velocity head and M number and allows to employ aircraft manoeuvreability more completely.

When in emergency, the aircraft is controlled with the help of the electric servomechanism, the pilot will feel some play and greater efforts on the control column as compared to those when the aircraft is controlled with the help of the booster - in this case the control column travels but slower and the stabilizer, irrespective of the efforts, is transferred by the APS-4 electric mechanism at a speed of 4°,5 per second (9° 4 per second for the [illegible] electric mechanism).

The pilot cannot control the stabilizer by hand because the hinge moment of the stabilizer varies considerably in flight, therefore the emergency control system is quite necessary.

The vertical tail unit has a 57°30' sweepback angle. The keel underneath occupies 0.614 m^2.

The rudder control system is of a rigid type.

The aircraft has three air brakes. Two air brakes, which are located at the aft part (on both sides), have a total area of 1.04m^2 and an angle of deflection of 25°.

The third is located at the middle bottom and has an area of 0.45 m^2 and a deflection angle of 45°.

At the aft bottom compartment there is a container with the PT-19 brake chute.

The aircraft hydraulic system is divided into two systems - the main system and the system of boosters. Each system has a hydraulic tank and a pump group; pressure in both systems is identical. The main hydraulic system is served by the starboard engine pump and the system of boosters - by the port engine pump. The main hydraulic system is meant for controlling the retraction and lowering of the landing gear, flaps, air brakes and shutters of the jet nozzles as well as for substituting to feed the boosters in case of failure of the boosters system.

The aircraft air system ensures the usual and emergency braking of the landing gear, emergency lowering of the landing gear and flaps, discharging and recharging of the weapon, releasing and seperating of the brake chute, emergency throwing-up of the movable hood, pressurising of the cockpit, closing of the shut-off fuel valves, functioning of the anti-icer system.

The aircraft fuel system includes four fuselage tanks with total capacitance of 2150-2120 litres and two drop tanks.

The aircraft is armed with artillery, bombing and rocket weapons,

The aircraft artillery consists of three NP-30 cannons with 201 rounds and the gunsight of ASP-3n type.

The bombing armament includes two BD-3-56 bomb racks carrying two bombs from 50 to 250 kg.

The rocket weapons contain two OPO-57k units with eight C-5 shells in each.

The belt links are collected for each gun, cartridge

canopy are pushed outside.

The aircraft has the armoured glass (in the windshield), armoured plate installed in front of the cockpit, armoured protection of pilot's head and back, and the plate protecting the breech block and cartridge of the firing mechanism.

The aircraft radio equipment includes the VHF receiver - transmitter of RSIY-4 type, the CRO friend and foe responder, the Sirena-2 set for tail protection, the radio range finder of SRD-1m(cone) type coupled with the AGP-5N sight, the equipment and instruments of the OSP (blind landing) system which contaiats the RV-5 radio compass, the RV-2 radio altimeter for low altitudes, and the marker radio receivor of MRP-56P(MRP-48P) type.

I. PREFLIGHT PREPARATION

All flights above 4000 metres should be performed with the KM-30(KM-30m) oxygen mask on, with obligatory usage of the aircraft oxygen equipment and with the KP-27M chute oxygen apparatus being available.

It is allowed to fly below 10 000 metres without the BKF-2(BKF-2m, BKF-3m) pressure suit.

All training flights to the zone and the air combat as well as flights at an altitude above 10 000 metres must be performed in the pressure suit.

All flights are to be performed with the chutes of C-2 and C-3 type.

1. After getting the chute, examine it and check:

- the fastening of the pin of the automatic switch wire and the oxygen pressure in the chute oxygen apparatus (130 - 150 kg/cm^2);
- that the KAP-3 is available;

Note. The KAP-3 should be set for functioning in 2 seconds at 1 000 metres above the ground.

- the flexible thread of the automatic device-for presence and the correct packing of the pull-out rope under the rubbers (the rope must be packed in a zigzag-like way into the loops of the pack rubbers or into the special pocket),
- the serviceability and reliable fastening of the automatic device hose with the chute hose;
- the fixing of the automatic device hose on the support strap of the chute cover;

- the connection of the automatic device wire with the chute rip chord, and the correct fastenning of the thread of the chute rip chord.

The inspection accomplished, close the chute flock.

3. Prior to putting on the KK-2 (B.I.-2m, B.I.-3m) suit adjusted beforehand you should check its serviceability seams, tension device, anti - G device, laces and clips for absence of damage. The suit should be put on the special linen.

After putting on the pressure suit, check whether it fits tight. If not, adjust it by laces.

Aircraft Inspection

3. Prior to flight the pilot must get the technician's report on the aircraft readiness to flight and get to know how the aircraft has been filled up with fuel, air and oxygen as well as what work has been done on the aircraft after the last flight.

4. Outside the aircraft check to see that:

- the aircraft skin, landing gear and aerials are in good conditions;
- all covers and plugs are removed;
- the oil, hydraulic mixture and fuel are not leaking;
- the aileron and rudder trim tabs, the trailing edges of the stabilizer, rudder and flaps are in proper position they position must be as follows: the aileron and rudder trim tabs - according to the legend on them, the trim tab fixed to the rudder trailing edge
- in balancing position (indicated in the balance chart), the trim tabs fixed to the trailing

edges of the stabilizer, ailerons and flaps, and regulated on the ground - in zero position (when along the chord).

N o t e: Explanations on possible "scissors" of the flaps, ailerons and on cases when the ailerons are down despite the neutral control column, used for lateral aircraft balance, are given in " Methodical Instructions on Aircraft Balance in Workshops".

- the shutters of the jet nozzles are open.

Cockpit Inspection

5. Before entering the pilot's cockpit ensure that:

- the pyromechanism is charged (the red pin must be out of the head) and the head is wirelocked;
- the cover for face protection and the triggers on the seat hand rails are wirelocked,
- the handle for emergency hood jettisoning is in "Закрыто" (closed) position and wirelocked;
- the landing gear control lever is neutral and looked by the latch;
- the battery and all circuit breakers of the weapons, bombs, tanks, radio and electric equipment are OFF and all protectors for buttons and switches are closed;
- the fire control trigger is guarded by the look,
- the necessary for flight circuit breakers under the transparent cover on the starboard are OFF;
- the switches of two boosters on the left panel are ON;
- the cock for cockpit feed is open;
- the necessary code is set on the code switch, if the aircraft is not equipped with the latter - set the code on the friend and foe responder panel;
- the ПОИ-0,5 wire is on the emergency brake lever;
- the stick latch, the ground safety covers of the ejection seat shooting and the safety latch of the explosion circuit are removed.

- there are no foreign objects, water and ice;
- the AB-3 mechanism for releasing the safety harness (set for 1.5 sec) is cocked and check how the rip chord is fixed to the harness lock, and the rope of the flexible thread - to the aircraft side;
- the wire of the OPK-1m(OPK-2) lower socket unit is linked with the left guide of the ejection seat;
- the safety harness is set straight;
- the safety pins of the firing gear controls of the ejection seat and the control column arrester are removed.

6. Check the systems for the available air. The pressure should be as follows:
- in the main air system - 110-130 kg/om^2
- in the landing gear emergency system - 50 kg/om^2;
- in the bottle of the system designed for tossing up the hood - 110 - 130 kg/om^2 (Fig.1);
- in the bottle of cockpit pressurization - 50 kg/om^2.

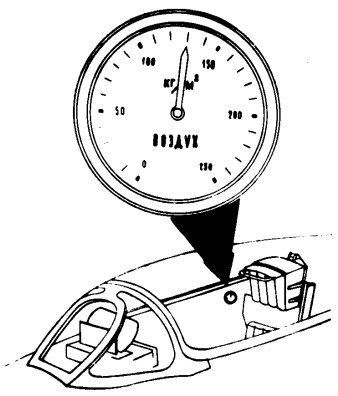


Fig.1. Check of Pressure in the Bottle of Tossing up the Hood (pressure should be 110-130kg/om^2)

7. The chute can be put on the seat beforehand. In this case prior to entering the pilot's cockpit all the hoses, ropes and oxygen mask must be linked; the chute harness should be put on in the cockpit with the help of the technician.

Entering Pilot's Cockpit

9. If the chute is not put in the cockpit beforehand, the technician will assist you to link the KP-27M with the aircraft oxygen system, and the hose of the KAP-3 flexible thread with the ring on the left side of the seat.

9. Put your feet under the loops on the pedals and check the pedals for proper length.

10. Adjust the ejection seat (pilot's eyes must be in level or above the centre of the gunsight reflector).

11. Link the hoses of the tension and anti-G devices of the pressure suit with the corresponding hoses on the upper socket unit.

12. Fix the upper socket unit in the chute harness.

13. Release the shoulder straps (move the adapter forward), fasten them, press yourself tight against the seat back, look the straps (move the adapter backward) and tighten first the waist belt and then the shoulder and fifth straps.

14. Order the technician to remove the safety pin from the firing gear.

15. Check the adapter of the shoulder straps for good operation. For this purpose:

- shift the adaptor to the extreme forward;
- bent forward to find out the aping pull;
- press yourself tight against the seat back, move the adaptor backward and check its serviceability.

16. Check the clocks.

17. Set the altimeter at zero and make sure that the altimeter readings on the barometric pressure scale correspond to the ground surface pressure given by the weather station.

18. Move engine controls to check free motion and their reliable fixation in "Стоп","Малый газ" and intermediate positions.

At the aircraft not equipped with buttons for switching ON the afterburner and maximum operating conditions check fixation of engine controls in "Стоп" (stop), "Малый газ" (idle run), "Номинал" (nominal), "Максимал" (maximal) and "Форсаж" conditions.

19. Check the KKO-1(KAO-1m), for this purpose:
- make sure that the oxygen system is fully up (130-150 kg/cm^2);
- link the mask with the pressure control and fix the latter by the lock on the left leg loop of the chute;

N o t e. When flying below 10 000 metres with the KM-30(KM-30m) mask on and without the BBK-2(BBK-2m, ЗВУ-3m) pressure suit, the hose for delivering oxygen into the suit must be closed and the oxygen supply handle on the ДУ-2/ДУ-1/ panel must be in "Нейтрально" (neutral) position.

- link the helmet oxygen pad with the mask and the mask with the helmet, the laces being loose at a moment.

a) Check the set under excess pressure:

- put on the oxygen mask, turn the suit oxygen supply handle located on the КУ-2/АУ-1/ panel from neutral position to "Включение костюма" position and check by finders the holes on the pressure control unit;

- gain an excess pressure of up to 1 000mm of water column in the mask on the П-1000 manometer by smooth left-side rotation of the hand wheel of the excess pressure regulator, and then try to breath in and out; if, while inhaling, the pressure runs down on the П-1000 manometer, and if, while exhaling, the pressure runs up and the pressure suit becomes more tight due to increase of the excess pressure in the mask, the set is quite serviceable.

This accomplished, turn:

- the suit oxygen supply handle in neutral position,

- the hand wheel of excess pressure to the extreme right.

N o t e. It is forbidden to fly in the ВКК-2(ОКР-2, ВКК-3п) suit, if the hoses of the tension device or its chambers are broken.

b) Check the set without excess pressure.

Try to breath, with the suit oxygen supply handle being neutral, the hand wheel of excess pressure-extreme right and the suction-handle in «100 O_2» and "Смесь" (mixture) positions. If the indicator segments diverge and then converge, the set is quite serviceable

20. Switch ON the battery and the /2nd tank pump/ circuit breaker, and check the battery for charge, the tension being not below 24v.

This done, switch ON the "Насос 2-го бака"

(2nd tank pump) circuit breaker.

21. Order to switch ON the ground battery and, after the technician has reported "Battery ON", check the tension, /must be 28-29v/, if the АРА-7 or АРА-2 are engaged.

22. Turn ON the "Автомат тормозов КО" (automatic wheel brake) circuit breaker and check the braking system for good operation and the brakes for correct adjustment. At the beginning of braking the gauge should read 5 kg/cm^2. If the brake lever is fully pushed and the brake pedals are neutral, you will make sure that the air is not leaking and the brake gauge reads 10 + 0,5 kg/cm^2. Check for accurate and simultaneous unbraking in both cases.

If the pedal is pushed, the pressure in the wheel brake system will drop down to zero as quickly as 5 seconds.

N o t e. 1. Check the operation of the brake system, with the nose wheel being braked.

2. If the ambient air temperature is below zero, together with pushing the brake lever order the technician to check whether the brake shoes may be shifted.

23. Check the landing gear signal system and the tell-tale lights - three landing gear down green lights should shine; when you push the button located on the landing signalizer, all lights of the signalizer as well as the light on the flaps control panel indicating the flaps landing position will shine.

24. Switch ON circuit breakers "Приборы двигателей

противопожарное оборудование, сигнализация помп I,3,4-го баков"
/engine instruments, fire extinguishing equipment, pump signalization 1st, 3rd, 4th tanks/.
In this case the following lights will show: both light; "Генератор выключен" /Generator OFF/, the first tank light on the power plant panel, the lights for the 3 and 4 tanks and the drop tanks light.

When the button on the power plant panel and the "Контроль лампы пожар" /fire lamp check/ button are pushed, all the lights on the panel and the "Пожар" /Fire/ light will show.

25. Check that the fuel consumption indicator scale corresponds to the fuel amount. The fuel consumption indicator will read 2100 kg if the tanks in the wing are full up. If the drop tanks are available the fuel consumption indicator will show due to their filling. The fuel indicator should read "1400" (Fig.2.)

26. Check the "Падение давления в гидросистеме" /drop of pressure in hydrosystem/ light for show.

27. Put on the circuit breakers "Триммеры элеронов и РП, триммерный эффект" /aileron and rudder trimmers, trimmer effect/ and "Управление ПВГ-2 стабилиз" /stabilizer control/ and make sure the lights indicating the rudder tab neutral and the trim effect mechanism lights are shining. To check the trim effect mechanism for good functioning you shift the button on the control column to and fro; the control column will follow the button movements. The check accomplished, set the trim effect mechanism neutral /Fig.3).

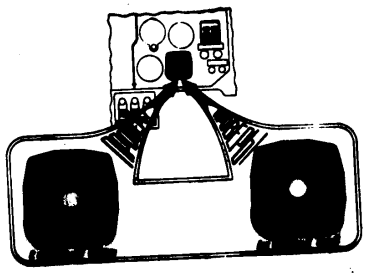


Fig.2. Check before flight how the fuel consumption indicator readings correspond to fuel quantity.

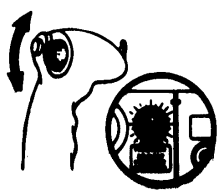


Fig.3. How to set the trim effect mechanism neutral.

28. Check the electric control of the stabilizer and the АРУ-2. For this goal:

- make certain that the green tell-tale light "Посадке лампа не горит - переходи на ручное управление АРУ" is shining;

- make push-pull movements to check the control column for smooth operation and ensure that the efforts from the load mechanism are available, the control column must assume neutral position;

- set the АРУ-2 selector switch in "Ручное" position and engage it, briefly the push switch turn the АРУ red in small arc monitor, the green light will die out and the indicator pointer will be extreme right(Fig.4).

Set the selector switch in "Автомат" position, in this case the indicator pointer will gradually return to extreme left and the green light will show(Fig.5).

C A U T I O N. It is forbidden to check the АРУ-2, if the "Управление МУС-2 стабилизатора" circuit breaker is OFF.

29. Push the starting button of the artificial horizon to the limit, switch ON the circuit breakers "ГПК-I, АГН-I" , release the starting button after 3-4 second pushing and check the artificial horizon for correct operation but not before 2 minutes. It will show the aircraft attitude at the moment.

N o t e. If the ambient air temperature is below - 30°C you should push the button for 5-8 seconds after the circuit breaker has been ON.

Push the button to synchronize the ГПК-I system and compare the compass readings with the aircraft course.

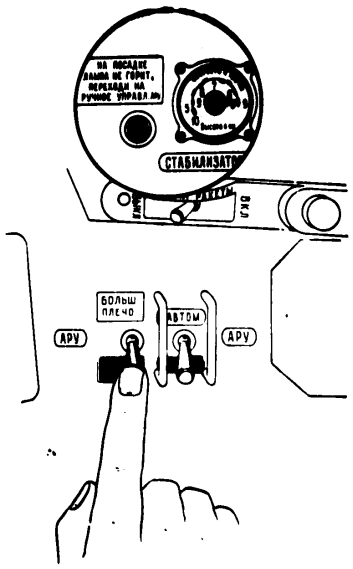


Fig. 4. How to check the stabilizer control in "Ручное" position.

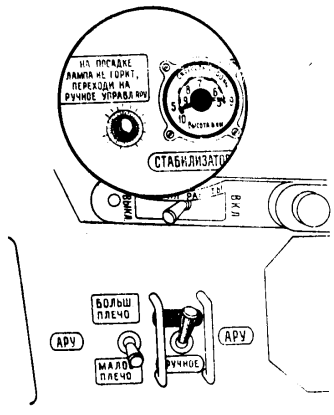


Fig.5. How to check the stabilizer in "Автомат" position.

30. Switch ON the circuit breakers "Питание кабины, ЭУП-53, противосблесковитель, кабинная лампа, левая задняя УФО" and wait 30 seconds. Check the turn indicator for correct operation, for this press slightly upon the instrument panel to the right or left of the turn indicator and the pointer will deflect to the corresponding side.

31. Switch ON the circuit breakers "Радио, АРК, МРП, СПО [redacted], расходомер" and check the АРК-5 for good functioning and correct tuning to the outer homing station and the inner homing station.

33. Switch ON the circuit breakers "РВ-2, МРП" and, as soon as the lamps get warmed, check the РВ-2 operation at both ranges.

34. Switch ON the "Сирена" circuit breaker and prepare the horn for service.

Check before Air Firing Flight and Bombing Flight

35. Get the technician's report that the armament and camera guns are ready to firing and bombing. The technician must report:

- which guns and jet armament units are prepared for firing;
- how many shells are available for each gun and jet armament unit;
- what is the colour of shells (in training fire);
- how many reloads are required;
- what is the type of the suspended bombs and what is the time of delay set for the fuses.

36. Switch ON the circuit breakers "Обогрев прицела, "Прицел", "Конус" and check:

- the reflector glass and sunscreen of the sight for cleanness;
- the smooth change of brightness and sharpness of the graticule;
- the throttle twist grip and the span handle for smooth rotation within the whole range.

37. Turn the sight to "Пуск" and set the sight switches in "НР-30", "Ручной", "Радио" positions and check:

- that the red light "низкое напряжение" on the sight switch is shining;
- that the "Захват" green light is shining.

C A U T I O N: It is forbidden to switch ON the radio range finder until the "Прицел" circuit breaker is ON.

- that the "Захват" light dies out when pushing the "Сброс ложи" button.

Set the sight switch in "Оптика" position and check:

- whether the indicator pointer deflects when you manipulate the throttle twist grip, whether the diameter for the range ring varies and the graticule travels in vertical plane;
- whether the graticule goes up when you push the damping button;
- whether the graticule goes down when you turn the switch from "НР-30" position to "РС" position.

38. Set the switch in the "Бомбы" position, move the graticule down by manipulating the "Угол" handle and make sure that the "Угол" handle goes to zero and the

graticule moves up provided you turn the switch to "НР-30".

39. Set the sight at "Нейтр", switch OFF the circuit breakers the other way: "Конус",4Прицел" and "Обогрев прицела,прицел".

40. Check the signal system of the bomb armament. In this case the bomb suspension green lights should shine and the bomb life drop red light will show after you have turned ON the "Взрыв" switch. The check done, turn OFF the switch.

41. If you are going to fire the jet armament, check its signal system. For this purpose switch ON the "РС" circuit breaker and make sure that the yellow light indicating readiness and the white light indicating the quantity of shells for each jet unit are shining on the ПУ-2 signal unit (on portside). The check accomplished, switch OFF the "РС" circuit breaker.

42. To shorten manipulations for armament control in the air you must turn:

- the control unit to the required discharge;
- the switch controlling the way of bombing on the sight switch to "Ручной" position;
- the sight selector switch (provided the sequence of armament employment is known) to one of three positions: "РС", "Бомбы", or "НР-30".

Check before Night Flight

43. Prior to night flight you should check the aircraft night illumination equipment. For this purpose:

- switch ON the circuit breakers "Питание кабины, ЭУП-53, противообледенитель, кабинная лампа, левая задняя УФО";
- set required cockpit illumination by applying the white light rheostat,
- set the dimmers of the tell-tale lights on the power plant panel, landing signalizer and code panel in night flight position;
- turn ON the navigation lights, having set the switch in one of the required positions,
- ignite the fluorescent lights by applying the rheostats, adjust the light filters and set the light equipment in operating position;
- turn the lamps switch to "Рулежная" position and check the taxiing lamp for absence of damage, then turn the switch to "Посадочная" position and check the landing lamp for good operation and its ray for correct direction, this done, turn the switch to "Выключено"; position,
- switch ON the circuit breakers "Обогрев прицела" and "Прицел", check and adjust the brightness of the graticule,
- open the dimmers of the following tell-tale lights: "Пожар","Маркер","2-й бак","3-й и 4-й баки", "Запуск в воздухе произвел, зажигание выключи","Генератор выключен", "Падение давления в гидросистемах";
- close dimmers to the required brightness of the following tell-tale lights: "Бомбы", "Взрыв", "Сигнализация подвесных баков","Наконечник двигателя","Триммерный эффект - нейтрально","На посадке лампа не горит - переходи на ручное управление АРУ","Триммер руля поворота нейтрально";
- adjust the brightness of the scale of the radio-compass control panel by rotating the handle "Подсвет";

- check the cap installed above the instrument panel and meant for elimination of specks of light and reflections of instruments on the hood glass for absence of damage and correct setting.

N o t e. The pilot should inspect the aircraft thoroughly only before the first flight. All next inspections at the same day (night) can be shortened due to the prescribed mission and the aircraft behaviour in the previous flight.

Aircraft Towing

44. When towing the aircraft lift Pitot tube and lock the sight gyroscope by turning the switch in "Непод" position.

45. It is allowed to tug the aircraft by the tractor at a speed of 10-15 k.p.h. on a concrete runway and 5-6 k.p.h. on a ground runway.

46. The pilot (technician) must seat in the cockpit during towing and be ready for immediate braking, if necessary.

47. At night the aircraft must be illuminated with the navigation lights.

Preparation for Starting

48. Ground batteries as well as the aircraft battery can be used for ground engine starting.

N o t e. To save the charge of the aircraft battery for emergencies you should not engage it but in case the ground battery is not available.

49. Prior to starting:

- ask the technician to be sure that the chocks are under wheels and there are no obstacles in front of the aircraft.

- set the throttle control levers in "Стоп" position.

50. Give the command to the technician "К запуску" /Be ready for starting/ and after the response "Есть К запуску" (Ready for starting) request starting permission, having get the permission, prepare the aircraft for starting. For this goal:

- switch ON both generators,

- switch ON all circuit breakers on the electric panel on the port side,

- check the system of starting engines in the sky; for this check put ON by turns the switch "Зажигание в воздухе" for 4-5 seconds and the red lights "Запуск в воздухе произвел, зажигание выключи" will show.

Then the technician must report functioning of the starting units of the engines.

N o t e. 1. Check the "2-ой бак" light for shining after switching ON the "Насос 2-го бака" circuit breaker. The lights "1-й бак", "3-й и 4-й б." will die out after switching ON the circuit breakers "Насос 1-го бака", "Насос 3-го бака" and "Насос 4-го бака" after switching ON the circuit breakers of both engines "Перекрывной кран, давление масла" the lights indicating "Нет масла". will show on the power plant unit.

2. If the aircraft batteries are engaged in starting, the circuit breakers "Насос 2-го бака", "Насос 3-го бака", "Насос 1-го бака", "Радио, АРК, [redacted] расходомер", "РВ-2, МРН", "Сирена".

should be switched ON after engines starting.

51. Employ the emergency braking lever, if starting on winter slippery ground.

52. The starboard engine is the first to be started and the port side [redacted] to be stopped.

53. Give the command "От двигателей". (Engines clear) and after the response "Есть от двигателей" (Engines clear) start the engines. For this purpose:

- place the starboard throttle in "Малый газ" position,

- push the "Запуск" button for 1-2 seconds; the engine must automatically, gradually, without "suspension" and coughing get the slow running conditions, the "Запуск в воздухе произвел, зажигание выключи" red light will be OFF indicating thus the end of the cycle of the electrical system.

C A U T I O N S: 1. Push the starting button for the first 10 seconds after setting the engine throttle at slow running.

2. When starting do not set the throttle between "Малый газ" and "Номинал" positions.

3. The engine should reach slow running within 80 seconds after pushing the starting button.

54. While starting, the gas temperature behind the turbine can briefly rise up to 850°C. If the gas temperature behind the turbine rises over 850°C, you must pull the throttle from "Малый газ" position to cut the fuel supply to the engine, and then, by manipulating the manual correction, set the engine for slow running

RPM without temperature rise over the permissable limit.

55. If on starting, the fuel does not ignite (no rise of gas temperature), you will briefly place the throttle in "Стоп" position and after the turbine has stopped running, scavenge the engine.

Engine starting may be repeated after the scavenging is over, i.e. the turbine is quite [redacted]

56. The port engine starting procedure should be identical with the starboard one. If you use ground batteries for starting, you will wave to cut them away after both engines are running. Ground batteries being OFF OFF, the generators tell-tale lights will die out.

57. To save the starting time when taking off by groups or by alarm, it is permitted to start only the starboard engine from ground batteries, and then start the port side engine with the starboard engine operating at "Малый газ".

C A U T I O N. In case of failure of the second engine, while the first engine is running, (gas temperature rises above permissible limit, fuel does not ignite, RPM do not increase 10 seconds after the "Запуск" button has been pushed, and so on), you should cut off the running engine and stop starting the second engine by placing the throttle in "Стоп"position.

If the fuel burns out in the failed engine, you should scavenge the engine after its rotor has stopped. Repeat starting only after the [redacted] have been eliminated or the engine has been [redacted]

If you do not do it, the flame can leak into the compressor and destroy it.

58. When necessary, the starting of the engines with manual correction should be performed in the following sequence:

- switch ON the circuit breaker which you use for automatic starting, the throttle lever being in "Стоп" position;
- push the "Запуск" button for 1-2 seconds and then in 1-2 seconds place the throttle lever gradually and slowly in slow running position, avoiding the increase of the gas temperature behind the turbine over 850°C.

Warming and Testing of Engines on the Ground

59. After the engines are started and brought into slow running conditions for 0.5-1 min., check up readings of the instruments which must be the following:

- R.P.M. 4100-4300;
- gas temperature after the turbine no more than 650°C.
- the warning lamp of the oil pressure may glow or blinkers up to 6000 R.P.M. after which it must die out.

C A U T I O N S : The engines continuous work on the ground under slow running conditions up to the R.P.M. number when the by-pass strap of air closes is permitted for not more than 5 min. to avoid overheating the members located in the engine compartment. If prolonged work is necessary, cool the engines at the R.P.M. number when the by-pass strap of air is closed, i.e. over 6000 R.P.M.

2. Under the weather conditions causing ice formation (fog, drizzling sediments or moist snow under the outer air temperature from +5 down to - 5 C) the engines work on the ground and in the air on R.P.M. below 9000 must be as short as possible to avoid icing of the engines and their failure because of ice penetration into the compressors.

N O T E : 1. The by-pass strap of air is closed at 6000-6100 R.P.M. for engines of up to N Г 726257 exclusively and for engines with the NГ 726257 on.

2. R.P.M. at slow running depend on the outer air temperature; if it is -30°C or lower, the R.P.M. must be not less than 4100; outer air temperature being + 30°C and higher, R.P.M. must not exceed 4300.

Develop 10400 R.P.M. and work for 0.5-1 min. to warm up the engine.

60. Having braked all three wheels, put smoothly the engine control lever on the "MAXIMUM" stop. There the engine R.P.M. must be 11150±50, gas temperature behind the turbine must not exceed 550°C and the oil pressure warning lamp must not glow.

If necessary, one should check up the engine work under maximum and augmented conditions. Check up must be performed on a specially equipped ground.

The instruments must read:

a) under maximum conditions

- 11150± 50 R.P.M.;
- gas temperature behind the turbine up to 650°C;
- gas temperature on the ground behind the turbine on the engine where the 8th and 9th stages of the compressor are modified must be below 670°C;
- the warning lamp "MAXIMUM AUGMENTED" glows (on the aircraft with the button switch);
- oil pressure warning lamp must not glow.

b) under augmented conditions:

- 11150± 50 R.P.M.;
- gas temperature behind the turbine up to 650°C (for the 6th series engines;) and up to 650°C for engines of up to the 6th series) at the outer air temperature up to 15°C (if it is over 15°C - gas temperature must not exceed 680°C);

- warning lamp " [illegible] " glows;
- oil pressure warning lamp must not glow.

N o t e : The chapter "Engines control in flight" deals with the procedure of switching on and off the maximum and augmented runnings.

C a u t i o n. 1. The engines are tested by turns; it is permitted to increase power of both engines at a time up to 10 000 R.P.M.

2. If switch - on of the afterburner is followed by hunting or an increase of gas temperature exceeding the adopted limit, switch OFF the afterburner. The afterburner may be switched on once more only after the fault is found out and eliminated.

3. An engine test with afterburner must not exceed 10 sec.

61. Pull smoothly the engine control lever backward down to idle running. Under steady conditions and under conditions in between the engine must work without shaking.

62. Check up power response of the engine by moving the engine control lever for 1,2-2 sec. from the idle running to the nominal one (when necessary, from maximum up to augmented condition). While testing the power response an extra [illegible] temperature behind the turbine up to 750°C and R.P.M. [illegible] up to 11600(11900 R.P.M. for the engines of the 6th [illegible] are permitted for a shot time.

[illegible] power response under different conditions is [illegible]

T A B L E 1.

Conditions	Time of power response, in sec.	
	for the engines of series up to the 6th	for the engines of the 6th series.
Up to nominal	9 ÷ 12	11 ÷ 14
Up to maximal	9 ÷ 13	11 ÷ 15
Up to augmented	15, not more	18, not more

N O T E S: 1. If the engines of up to the 6th series have the HP-10 a pump with R.P.M. regulation at the beginning of automatic work which corresponds to the regulation work of the HP-10 ako pumps, the time of their power response will be the same as for the engines of the 6th series. 2. Extra gas temperature and R.P.M. jump in power response during flight is the same as on the ground. 3. It is FORBIDDEN to make an opposite power response for the engines of the 6th series.

63. While testing the engines, check up the generators work. The generators work with faults if their warning lamps "Temperatp znanven" do not glow under all conditions of the engine and voltmetre reads 28-29 volts. If one of the warning lamps " Temperatp znanven" [illegible] of them or both blinker, switch off the [illegible]

Hydraulic System Test

64. While testing the engine on the pressure gauges that there is pressure in the main hydraulic system and in the hydraulic amplifiers system (the red warning lamp must not glow) and check:

a) control of the flaps by extending them 2-3 times in take-off and landing positions; their extension by checking due to the warning lamp (pointers) on the flaps control panel and by the respective engineer's controls; if [illegible] of the flaps by checking due to glow of [illegible] on the engineer on the landing board, then retract the flaps back, if necessary, put them in the take-off position.

b) the air brakes control by the push-button on the control column, and also by the slider on the right engine control lever; the air brakes extension is checked by the shining of the lamp "Щитки выпущены" on the landing board.

c) aileron control with hydraulic amplifiers off and on:

- when it is off, check whether the ailerons move smoothly and there is some effort from the loading mechanism and the control column goes fully from one side to another;

- when the hydraulic amplifiers are on, move smoothly the control column three-four times to the extreme right and left; thereat the column must move freely without jamming and sticking; one should feel only resisting effort of the loading mechanism.

Make sure that pressure in the hydraulic amplifiers system (after the column is stopped) regains 135± 7 kg/om^2.

N O T E : When there is no pressure in the hydraulic systems and the electric feeding of the emergency electric system controlling stabilizer is off it is impossible to move the column longitudinally.

Stabilizer Control Check.

65. The stabilizer work controlled by the main hydraulic system is checked after the right engine has been started and assumed idle running (the left engine still off).

For that do the following:

- make sure that the main hydraulic system has 135± 7 kg/om^2 pressure;

- move smoothly one-two times the control column into the extreme backward and forward positions, thereat the column must move without jamming and jerking, the pressure gauge pointer will oscillate which tells of the work of the hydraulic amplifier from the main hydraulic system; then letting the column free in one of the extreme positions, it must return to the neutral position.

66. The stabilizer work controlled by the hydraulic amplifier system is checked after the left engine has been started and the system gained 135±7kg/om^2 pressure.

The procedure of check is the same as in paragraph 65. For the check see oscillations of the pointer of the amplifier pressure gauge.

67. Directly before taxiing to take off, both hydraulic systems having pressure 135±7kg/om^2, check the stabilizer emergency electric system for which:

- switch off the stabilizer hydraulic amplifier;

- by pulling backward and pushing the control column forward make sure it moves smoothly;

- [illegible] that the [illegible]

- switch off the stabilizer hydraulic amplifier and make sure the stabilizer is controlled by the main hydraulic system.

Preparation for Taxiing and Taxiing flight.

63. Before taxiing check whether the cockpit pressurization is good. When the canopy is closed and the pressurization lever located at the left look of the canopy travelling part is moved forward (fig.6), air will be delivered into the pressurization hose and the canopy is a little bit lifted.

Feel by hand against the holes of the tube that air is delivered from the engines into the cockpit.

No smoke or other smell should leak into the cockpit.

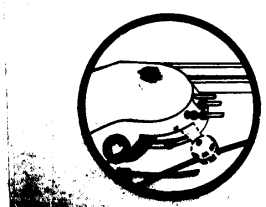


Fig. 6. The cockpit is pressurized by [illegible] in the forward position.

69. Having made sure that the engines, instruments and aircraft units work well and pressurization is good, [illegible] the harness, ask the flight directing officer for a permission to taxi out.

70. Before taxiing out make sure that the emergency braking lever is in the forward position, the front wheel brake is off, the undercarriage cock lever is unlocked and the hydraulic amplifiers controlling the stabilizer (fig.7) and ailerons are switched on.

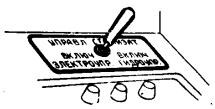


Fig. 7. The stabilizer hydraulic amplifier is switched ON.

71. Order "Убрать колодки" /you wave the chocks away!/ and brake the wheels.

72. After getting the permission to taxi out check whether all the circuit breakers of the equipment needed in flight are on.

73. When taking off from a short runway or taking off with fuel drop tanks, extend the flaps in the take-off position (15°).

74. Being sure that the chocks are removed (the ground engineer gives signal) and that there is no obstacle in front, check up the brake operation: the brakes must hold the aircraft at 40 000 R.P.M. After that put the engine control levers at the idle running stop.

75. Make sure once more by yourself and from the ground engineer's signs that the way for taxiing out is free, release brakes and taxi out. Taxiing speed must not exceed 30 K.p.h.

Caution: Several aircraft taxiing out at a time and being not provided with dust proof nets, keep a necessary distance (considering the direction and wind velocity) between the aircraft to ward off penetration of hard particles into the engine compressors.

76. Having taxied out up to the runway, make sure it is vacant and ask the permission to engage the runway.

77. On the runway taxi straight 5-10 metres so that the front wheel will go along the take-off line, after that brake it (for which turn the brake handle to the extreme left in the horizontal position).

If the weather conditions may cause ice formation, switch on the circuit breakers "Obogrev", "Anap.TM-156" / Pitot tube, stop watch, emergency TP-156/.

II. TAKE-OFF, CLIMB

TAKE- OFF

78. After getting take-off clearance, don't delay on the runway, increase engine speed up to 9000 R.P.M. (check engines for proper speed), release brakes and start running increasing engine speed up to take-off r.p.m. Take-off must be carried out at rated, maximum and, if necessary, augmented conditions.

Hold the control stick neutral at the beginning of run.

79. If at the beginning of run the aircraft commences to swing to either side, the swing should be eliminated by applying the brakes. As the aircraft speed grows, maintain the direction by operating the rudders.

The aircraft on run has no inherent tendency to ground-loop. The cross-wind blowing with a speed of 15 meters per second and at an angle of 90° to the runway does not considerably influence the straight run.

80. As the aircraft gathers 180-200 km.p.h. pull the control stick smoothly by 2/3 of its travel and keep on running. At a speed of 230-250 km.p.h. the aircraft will gradually lift the nose wheel off the ground but the pilot has to hold the aircraft, until it takes the air, so as to have the upper contour of the aircraft nose projected upon the natural horizon. The aircraft will come off the ground easily at 280-300 km.p.h. and it has a tendency neither to ballooning nor to stalling.

81. In the air the armoured window will hamper to judge the distance to the ground, therefore the port window will be the best way to observe the ground.

82. Retract the landing gear at an altitude of 10-15 metres. Speed should not exceed 550 km.p.h. until the landing gear is fully up because at a greater speed of flight the landing gear will go up slower and sometimes not be retracted completely. Normal retraction time is 7-8 seconds. Check the landing gear for retraction by the tell-tale lights, pop-up indicators and full hydraulic pressure. This accomplished, set the landing gear control lever in neutral position.

C A U T I O N. Do not set the landing gear control lever in the neutral position until the speed decreases to 500-550 km.p.h., provided one of the tell-tale lights does not show after retraction at a great speed.

83. The aircraft tail will be a slight heavy if coming off the ground with 15° flaps. Retract the flaps at an altitude of 100 metres (after the landing gear has been retracted). Actually, the pilot will not feel the aircraft sinking. The flaps being in take-off position, an indicated speed should not exceed 800 km.p.h.

84. When operating from a concrete runway at maximum engine speed with 15° flaps, the take-off run will be 600-650 metres and take-off distance (till H=25 metres) -1300-1500 metres.

85. Take-off with both engines operating at augmented conditions and with the flaps up is carried out to shorten take-off distance. Just prior to take-off the pilot must press the brake lever for all three wheels, increase R.P.M. till the aircraft starts to move (10000 -10800 r.p.m.), then release the brakes and shortly, missing the intermediate conditions, snap ON the afterburner. Check the engines for augmented conditions: the tell-tale legends will show and the run speed will grow immediately.

When taking off at augmented conditions, the stabilizer will need more deflection for lifting the nose wheel.

The take-off run will shorten to 515 metres.

86. If the afterburner of one of the engines does not operate on run, the aircraft will swing to this engine side. However, it does not complicate the take-off procedure and cannot be a cause for ceasing the take-off. The aircraft tendency to ground-loop is to be eliminated by applying the rudder and brakes.

Unless the afterburners of both engines are ON, the pilot may either cease taking-off, if he has noticed it at the beginning of run (approximately as far as 100 metres from the take-off position line), or may keep on taking off at maximum engine speed, if the pilot has noticed it at a great distance from the take-off position line.

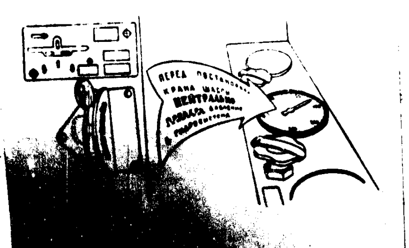
C A U T I O N. Put the landing gear control lever in neutral position after the landing gear up lights have shown and the full hydraulic pressure has been obtained in the main system. (Fig.8) If the landing gear is not up (one of the tell-tale lights does not show), you will switch off the afterburner and at a speed of 500-550 km.p.h. repeat the retraction.

C L I M B

87. Climbing, as a rule, should be performed at maximum engines power which ensures minimum time and fuel consumption. To save climb time the pilot can resort to augmented conditions.

88. The average speed of fastest climb to the service ceiling at rated and maximum engine R.P.M. is to be equal to [illegible]30-950 km.p.h. (by the thin pointer).

89. Climb to the service ceiling with the afterburner ON t[illegible] speed corresponding to M=0.88-0.9.



[illegible] gear UP position of the [illegible] pressure equals 135±7 kg/cm².

The best altitude for putting the afterburner ON is 7 000 - 8 000 metres. In this case the climb will require less fuel than that performed at maximum power.

When operating at augmented conditions to 7 000-8 000 metres, the angle of tail heaviness is unusually great and the horizontal line of the AГИ-1 is out of pilot's field of vision. In this case the pilot can orient himself by the vertical line and divisions of tail heaviness angle on the artificial horizon in compliance with speed and M indicator. At altitude over 7 000 - 8 000 metres the artificial horizon indicates normal readings.

C A U T I O N S: 1. The time of continuous engines running at maximum and augmented conditions and the total time of continuous engines running at these conditions should not exceed 6 minutes below 6 000 metres and 10 minutes over 6 000 metres.

2. The pilot can operate again at maximum or augmented conditions only after the engines have been cooled at rated or any other conditions within one minute.

90. On climb the gas temperature behind the turbines must be:

- at rated engine speed - not over 590°C,
- at maximum conditions - not over 6[illegible]°C,
- at augmented conditions - not over [illegible]

for the engines of the 6th series and 620-680°C [illegible] engines prior to the 6th series. [illegible]

91. To maintain easily the climb conditions [illegible] should trim the pulling efforts on the control [illegible] applying the trim mechanism [illegible]

N O T E: Change [illegible] to [illegible]

APY -2 causes the stopped change of the APY shoulder which requires slight impulse deflection of the control column to maintain the flight conditions. This phenomenon is most appreciable on climb up to 6 000 metres, especially when flying with drop tanks.

III. GENERAL OPERATING CONDITIONS OF FLIGHT

Permissible Operating Conditions

92. The maximum permissible speeds of flight for the aircraft without external suspensions are the following.

- up to 10 000 metres -indicated speed is 1100 km.p.h. (by the thick pointer),
- over 10 000 metres -true speed is 1700 km.p.h.(by the thin pointer).

Maximum operating overload -8.

CAUTION If the right light shows indicating that the hydraulic pressure has dropped, do not exceed an indicated speed of 650 km.p.h. in the aircraft equipped with the AMC -4 electric mechanism.

93. The speed of flight increasing up to the permissible limit, the aircraft behaviour mainly remains normal, in this case a slight change of the longitudinal balance may be easily eliminated by [illegible] the control column.

However, there are the following peculiarities:

- [illegible] altitude up to 9 500 metres lateral [illegible]
- [illegible] altitude below -8000 metres when [illegible] decreasing the engines speed

transmission ratios from the control column to the stabilizer and the loading mechanism according to change of the indicated speed and flight altitude.

100. Check the APY-2 for good operation by the indicator shewing the position of the APY arm. The indicator is located on the instrument panel. The scale of the indicator has double calibration: from the left to the right for speed (outer scale) and from the right to the left for altitude (inner scale).

In the abovementioned limits of regulation the pointer of the indicator reads indicated speed and altitude to which the position of the [illegible] acting rod corresponds in some definite moment of the flight (Fig.9) hereat:

and extending the air brakes momentary longitudinal oscillations of the aircraft appear and one feels a change of efforts on the control column as a result of change of longitudinal balance by M numbers, while flying at speeds corresponding to M=1.02 ÷ 0.9.

C A U T I O N. Should the pedals begin to pulse when close to speed limits, stop gathering speed.

94. If longitudinal rocking of the aircraft appears during flight do not try to get rid of it by deflecting the control column. In order to eliminate rocking it is necessary to fix the control column immovable and the oscillations of the aircraft will fade. When necessary decrease the engines R.P.M. smoothly and put the aircraft into climbing to decrease the speed of flight. Extension of the air brakes causes in this case an increase of rocking.

95. To use the air brakes is allowed at all permissible speeds of flight. Extension of the air brakes causes a slight vibration of the aircraft.

96. The evolution indicated speed at all altitudes is equal to 950 km.p.h. At this speed the aircraft is quite stable and controllable.

97. During training circuit flights an indicated speed of level flight with the landing gear up or down is 500 and 450 km.p.h., respectively.

[illegible] corresponding to M=1.2 ÷ 1.35 without [illegible] with them, the aircraft will have a [illegible] the side opposite to the rudder [illegible] mainly by ailerons [illegible] decrease the flight per[illegible]

а

б

Fig.9. A P Y readings.

a) -the pointer is extreme left at an [illegible] speed of up to 480 km.p.h. at any [illegible] speed -at [illegible] above 10 000 [illegible]

b) -the pointer is extreme right at an [illegible] of over 900 km.p.h. up to 5 000 [illegible]

- at an altitude below 5 000 metres the position of the pointer of the indicator on the speed scale(outer scale)must approximately correspond to the indicated speed,

- at an altitude from 5 000 up to 10 000 metres (for the APY-2A) and from 5 000 up to 15 000 metres(for the APY-2B) the position of the pointer on the scale must roughly correspond to the indicated speed,the pointer reads on the inner scale must not be less than an altitude of the flight at any speed,

- at the operating conditions of flight beyond the operation limits the pointer must occupy one of the extreme positions: at an indicated speed over 900 km.p.h. (at an altitude less than 5 000 metres) the pointer must be at the right stop, at an indicated speed less than 480 km.p.h.(at any altitude) and at an altitude over 10 000 metres for the APY-2A and 15 000 metres for the APY-2B (at any speed) the pointer must be at the left stop.

One should bear in mind that the readings of the indicator showing the position of the APY acting rod as for altitude and speed of flight may differ from readings of the flight instruments, and the difference increases together with altitude and may reach approximately 1000 metres at an altitude of 10 000 metres.

C A U T I O N S.1.If when gathering speed the pointer of the APY indicator lags behind the pointer of the speed indicator(the thick one) by more than 100 km.p.h. you should stop to gather speed, do not exceed a speed of 900 km.p.h. and perform landing.

2. If at an indicated speed of 900 km.p.h. and more (at an altitude of less than 10 000 metres for the APY-2A and 15 000 metres for the APY-2B) the pointer of the APY indicator travels to the left stop,

it is necessary to decrease the speed by smooth translation of the aircraft into climbing.

3. If while decreasing the speed the pointer of the APY indicator occupies the extreme right position, then it is necessary to stop fulfilling the mission. Prior to landing set the APY mechanism at the long arm position according to the indicator and shining of the lamp.

4. In case of failure of the APY controll unit the pilot can control the automatic mechanism by hand setting the APY-2 selector switch at "Ручное" position; in this case the arm of the automatic mechanism is to be changed by turning the hand control switch into either "Большое плечо" or"Малое плечо" positions. Fly...

During hand control flight difference between the indicated speed and the speed by the APY should not exceed 100 km.p.h.

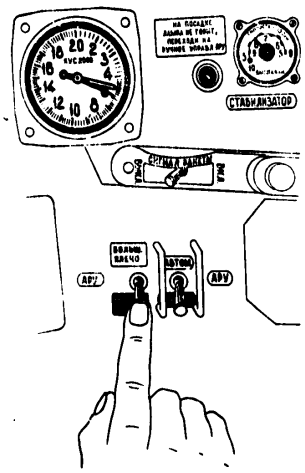


Fig.40. Pilot's actions in case of the APY failure (put the selector switch in the position "Ручное" and the arm switch in the position "Малое плечо" or "Большое плечо"

102. Level flight with "триммерный эффект" mechanism in neutral position may be performed within evolution and maximum permissible speed range at any altitude.

Flying within such wide range of speeds has some peculiarities:

- in a level flight with the after-burner ON at an altitude from 5 000 up to 7 500 metres a considerable push applied to the control column is needed,
- efforts applied to the control column with the APY turned to the "long arm" are considerably less than those with the APY turned to the "short arm" in this case all push-pull efforts are to be trimmed by the mechanism at any speed and altitude within the range.

103. When in level flight the aircraft gathers speed from M=0.97 to M=1.02, the airspeed reading will first increase because of aerodynamic and wave distortions of the flow by the Pitot tube, and the variometer will read climb with a vertical speed of up to 100 metres per second, and then the altitude will exceed the original one by 400-600 metres and the variometer will read zero.

104. In case of pressure drop on the boosters down to 65+5 kg/cm^2 the feeding is automatically switched over to the main hydraulic system. If now the pressure in the main hydraulic system drops to 50+5 kg/cm^2, the stabilizer booster will be automatically switched OFF (by a special valve - "ПУЭМ") and the emergency electric control will be ON.

The latter will be also ON automatically when the stabilizer booster is switched OFF.

105. Translation to the emergency electric control of the stabilizer for landing [illegible] is performed by switching OFF the stabilizer booster (air brakes retracted) in a level flight at an indicated speed of 500 up to 650 km.p.h.

Back translation to the hydraulic control (switching ON of the stabilizer booster) in the aircraft equipped with the АСП-4 electric mechanism must be done in a level flight at an indicated speed not exceeding 650 km/h.

At the moment of switching ON the booster the pilot should not apply efforts to the control column (balance the aircraft by the "Триммерный эффект" mechanism).

In the aircraft equipped with the АСП-4 НД electric mechanism back translation is permitted only in exceptional cases.

C A U T I O N: IT IS FORBIDDEN to use a speed exceeding 650 km.p.h. while piloting an aircraft with the АСП-4 by means of the emergency electric control. The aircraft equipped with the АСП-4 НД have no speed limitations while flying by the emergency electric control.

106. As far as time limitations of engines continuous operation at maximum and augmented conditions at various altitudes are concerned, they are the same in level flight as in climbing.

Continuous operation of the engines during flight within the range of slow running and RPM at which the belt will close the air by-pass is to last not more than 10 minutes.

107. Maximum speeds in a level flight under rated and maximum conditions are practically the same, but fuel consumption under maximum conditions is considerably greater than that under rated conditions. Therefore, in a level flight it is necessary to operate at maximum engines

speeds to save time necessary for gathering maximum speed and then fly at rated engines speed.

To save time necessary for gathering speed, it is allowed to switch ON the afterburners irrespective of flight altitude.

108. FLIGHT ENGINES CONTROL

Basic engines conditions for level flight.

T a b l e 2.

Conditions	Engine R.P.M.	Temperature of Gases behind Turbine	Permissible Time of Continuous Engines Operation
Augmented	11150±50	620-630°C for the engines up to the 6th series and not more than 680°C for the engines of the 6th series	5 min. at an altitude up to 6000 m., 10 min. at an altitude over 6000metres.
Maximum.	11150±50	Not more than 680° C.	5 min. at an altitude up to 6000 m., 10 min. at an altitude over 6000metres.
Rated.	11150±50	Not more than 550°C.	Not limited.
Slow running	4100-4300	Not more than 650° C	10 min.

N O T E: The R.P.M. corresponding to the position of the throttle control lever "НОМИН ЛЬН" depend on the flight altitude and speed. The table indicates the slow running conditions on the ground.

109. The more flight altitude the higher can be gas temperature, should the gas temperature exceed, the maximum permissible limit, it is necessary to change the engine conditions till the permissible temperature is obtained.

C A U T I O N. In flight one should try and avoid to operate at the engines speed at which the belt will open and close the compressor air by-pass.

110. In order to switch ON the afterburner, it is necessary to set the throttle control levers at "НОМИНАЛ" position and push for 1-2 seconds the button for switching ON the afterburner, or to shift the throttle control levers into " Форсаж" position if the aircraft is not equipped by buttons for switching maximum and augmented conditions.

The switching of the afterburner is to be checked by:

- shining of the tale-tell lights "Форсаж"
- push and increase of flight speed;
- change of the gas temperature when the afterburner gets ON.

N O T E: The afterburner can be put into service by the buttons at the maximum as well as at the rated engine speed. The afterburner can be also switched ON at a rated engine speed when another engine is functioning at the R.P.M. that are over those at which the belt opens the compressor air by-pass.

If one of the engines is functioning at slow running conditions or is completely out, the afterburner of another engine will be put into operation only at maximum engine speed.

2. When you switch ON the afterburner of one engine (by the buttons) the afterburner of another engine will be also switched ON if its R.P.M. are over those at which the end switch of the hydraulic retarder of the "НР-10 ako" (R.P.M. are over 10900-100) will go into operation, although the throttle control lever of this engine does not occupy "НОМИНАЛ" position.

C A U T I O N! When you switch ON the afterburner you can for a short period of time (but not more than 3-5 seconds) increase R.P.M. on the engines of the 6th series till 11500 and on the engines before the 6th series till 11400, do not allow the gas temperature to leap when the afterburner is switched ON.

111. The non-switching of the afterburner (the fuel in the afterburner has not ignited) can be determined by rapid drop of gas temperature behind the turbine below 500°C (without following increase of gas temperature during 4-5 seconds up to 620-680°C).

C A U T I O N! If the afterburner switching is accompanied with hunting or increase of gas temperature above the permissable level, you switch OFF the afterburner.

It is forbidden to switch ON the afterburner again until you find out the cause of the failure.

While shifting the throttle control levers through the "НОМИНАЛ" position and the intermediate positions of controllable afterburner operation (it corresponds

to R.P.M. change from 11 150±50 up to 10400+200), the engines will function within the thrust controllable range of the augmented conditions. The parameters of engines operation must not exceed the permissible limits prescribed for the augmented conditions (see para 108).

N O T E: It is not advisable to shift the throttle control levers within the thrust controllable range above 16 000 metres because the engines will likely cut off. At an altitude of 15 000 -16 000 metres the throttles should be shifted not slower than within 5 seconds.

113. To cut off the afterburner you move the throttle control levers behind the intermediate catch of controllable afterburner operation (10 400+200 R.P.M.) or press the locks and release the throttle control levers from the "Форсаж" position (if there are no buttons for maximum and augmented conditions); the lights "Форсаж" which are to die out and drop of engines thrust will indicate that the afterburner is OFF.

114. The afterburner of the right or left engine is cut OFF by switching OFF the respective circuit breaker "Аварийное отключение форсажа, максимала" (Emergency cut OFF of maximal, afterburner), the engine taking the nominal conditions. In such a case the maximum conditions of the engine are impossible.

C A U T I O N S:

1. If the afterburner of one of the engines has not been switched ON, the aircraft will turn towards the engine whose afterburner is not switched ON. This turn is counteracted by opposite rudder.

In formation flight before switching on the afterburner the formators must step down by 5-10 m. relative to the leaders.

2. To cut the afterburner at 10 400 R.P.M. and more /on the aircraft with the button switch/ is forbidden.

3. While switching off the afterburner the engine may increase its R.P.M. up to 11 600 revolutions/within 3-5 sec. only/ extra gas temperature in this case is not allowed.

115. The afterburner is surely switched on up till 14 500-15 000 m. under maximum engine conditions within 10-15 sec. at an indicated air speed of at least 450-500 k.p.h.

If the engines have no forechamber/carburetor/ afterburner starter the afterburner is surely switched on up till 11 000 m. at an indicated air speed of 400 k.p.h., the engine is being previously kept at maximum conditions at least 5 sec.

At high altitudes the afterburner can be switched ON but may be not. The less the altitude and the more the speed of flight the more the reliability of switching ON the afterburner.

N O T E: While switching on the afterburner it is not recommended to use the air brakes in order to avoid failure in proper operation of the nozzle flaps because of drop in hydraulic mixture pressure.

116. In order to switch on maximum engine conditions it is necessary to set the engine control levers up to "Номинал" /Norminal/ and press the button "Максимал" /Maximal/ for 1-2 sec., and if the aircraft has no button switch it is necessary to push the levers up to "Максимал" /Maximal/.

Maximum engine conditions are checked by the gas temperature after the turbine and if the aircraft has the button switch it is checked by the tell-tale lights "Максимал" /Maximal/ too.

N O T E : On the aircraft without button switch:

a) if the engine control lever of one engine is in position "Номинал" /Nominal/ and the other engine works at over 10 900-100 R.P.M., and if we press the button "Максимал" /Maximal/ maximum conditions of both engines will be switched ON.

b) the augmented conditions are switched to the maximum conditions by putting the engine control lever in the position corresponding to 10 000-R.P.M. then in the position "Номинал" /Nominal/ and by pressing the button "Максимал" /Maximal/ for 1-2 sec.

117. The maximum conditions are switched OFF by setting 10 900 - 100 R.P.M. (when the aircraft has the button switch) or by pulling the engine control lever from "Максимал" /Maximal/ position and it is checked by tell-tale lights "Максимал" /Maximal/ dying.

C A U T I O N : Temporarily it is forbidden to use the maximum engine conditions under control until the electric diagram of the maximum conditions on the aircraft with the button is changed. The maximum conditions are switched OFF by the circuit breaker "Аварийное выключение форсажа и максимала" / Afterburner and maximal are OFF, emergency/ of the left and right engines and by putting down about 10 700 R.P.M.

118. The fuel supply is checked by the fuel indicator and fuel consumption indicator.

The fuel indicator (with the scale till 1400 l.) reads the fuel supply in the 1st tank, the fuel consumption indicator reads the total fuel remain on the aircraft.

The fuel consumption from separate tanks is checked by stable shining of the tell-tale lights "Сигнализация подвесных баков" /drop tanks, lights/ "2-ой бак", "3-ий и 4-ый бак" / 2nd tank, 3rd and 4th tanks/, / See Fig. 11./

119. In non-drop tank flight first 600 litres of fuel are consumed from the 1st tank, then simultaneously from the 2nd, 3rd and 4th tanks, fuel remain in the 1st tank being constant (approximately 830-850 l.).

In drop tank flight first 600 litres of fuel are consumed from the 1st tank, then fully from both drop tanks, then 500 litres from the 1st tank, then as well as in non-drop tank flight.

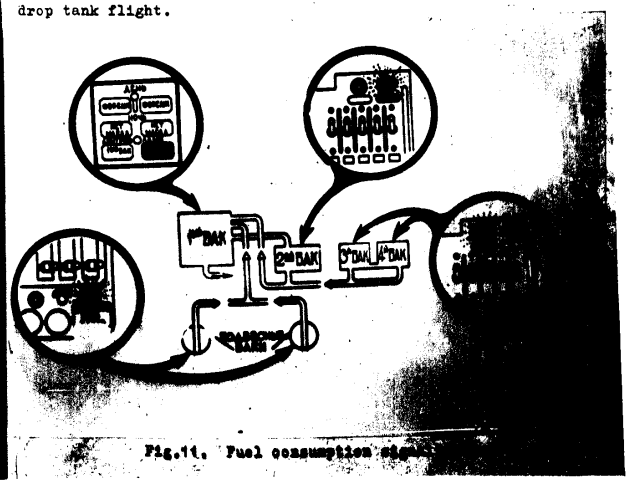


Fig.11. Fuel consumption sig[illegible]

C A U T I O N : The order of fuel consumption mentioned above may be changed. Fuel supply from the drop tanks and the 1st tank will be simultaneous if the engine consumes over 4 500-4 900 litres per hour.

If the fuel consumption exceeds 7000-8000 l.p.h. the engine will be supplied simultaneously from the 2nd, 3rd and 4th tanks as well as from the 1st tank and by the moment the fuel is consumed from those tanks the 1st tank may have less than 830-850 l.

After the fuel from the 2nd, 3rd and 4th tanks is used / in this case two green lamps "2-ой бак", 3-ий и 4-ый баки" / 2nd tank, 3rd and 4th tanks, will shine / switch OFF the corresponding circuit breakers so as not to put the pumps out of service prematurely.

120. The readings of the fuel indicator and the fuel consumption indicator are equal when the fuel is consumed from the drop tanks and 2nd, 3rd and 4th tanks. The fuel(830-850 l. or less)(see caution of para#119) remains only in the first tank.

If the tank has more than 830-850 l. the fuel supply is checked mainly by fuel consumption indicator;if less, it is checked by the fuel indicator. At the same time keep an eye on the emergency remain of fuel.

If only 550 l. of fuel remains, the lamp /550 литров/ /550 litres/ shines. This fuel is enough for 15 minute flight at an altitude of 500m. and a speed of 450-500 k.p.h.

E M P L O Y M E N T

OF AIRTIGHT COCKPIT

121. Flights in the MIG-19 S irrespective of altitude must be performed with a pressurized cockpit.

122. The cockpit is pressurized on the ground before taxiing out. For this purpose:

- close the canopy and after checking that the front locks have been locked correctly move the pressurization lever forward;

- make sure, that the air supplying cock is in the position "Открыто" / Open./;

- put the cockpit warning switch in the position "Автомат" /Automatic/.

In summer time it is recommended to take off with "cold" air supply; after the take-off switch on the automatic temperature system by putting the air switch in the position "Автомат" /Automatic/.

N O T E : When the air switch is put in neutral position the automatic temperature system and the cockpit is supplied with the air of the perature it had at the moment of switching the The temperature of the air delivered into the is in accordance with the engines ratings.

123. The pressure in the cockpit with automatically regulated by the RD-2U and UVPD 19 (altitude and pressure differen

N O T E : At altitudes higher than 8 000 m. in the normally working pressurized cockpit the permissible difference of pressure is 0.28-0.32 kg/cm^2. If more, the pilot must regulate it by the air supplying cock.

2. "altitude" inside the cockpit must be approximately half of that outside.

124. When the cockpit canopy sweats while descending from high altitudes it is necessary to:

- check up whether the air supplying cock is opened,
- check up whether the canopy is pressurized,
- put the switch of the air temperature regulator in the position "Горячий" /hot/ and increase the R.P.M.

125. The cockpit is unsealed on the ground after the flight is over before cutting off the engines.

USE OF OXYGEN AND OXYGEN EQUIPMENT KKO-1 (ККО-1 Е) IN FLIGHT

126. Before taxiing out to take off put on the oxygen mask.

127. The oxygen consumption in flight is checked by the pressure gauge and the work of the oxygen apparatus КР-30 (КР-34) by the ИК-18 indicator.

When the pressure gauge reads below 30 kg/cm^2 descend

to an altitude of 4 000 m and lower where oxygen use can be neglected.

128. In case of insufficient oxygen supply for breathing it is necessary to switch to pure oxygen supply by putting the air suction handle on the panel DU-2 (DU-1)in the position"100% O_2" (see fig.12).

129. After high altitude flight one may take off the oxygen mask at an altitude of 2 000 metre or on the ground after landing.

130. A long-time flight without anti-G suit in the unsealed cockpit is allowed at altitudes up to 10 000m.

131. In case of unsealing the cockpit at altitudes of 12 000 -18 000 m. the pilot may go on with flying for 10 min. in the anti -G suit 10 min. after that it is necessary to descend down to 10 000 m. Flight duration at an altitude of 10 000 m. depends on the oxygen reserve.

When the cockpit is unsealed at altitudes of 12 000 - 18 000 metres the oxygen will be automatically switched on within 1.5 -2.5 seconds and continuously delivered into the anti-G suit chambers and mask.

The VKK-2 (VKK-2m,VKK-3m) anti - G suit presses the pilot's body thus compensating the pressure of the oxygen delivered into his lungs. The more the flight altitude, the more the oxygen pressure delivered into the pressure suit and mask.

At an altitude of 7 000 - 8 000 metres the oxygen supply [illegible] unsealed cockpit [illegible] automatically [illegible] suit dumps.

N O T E : At altitudes higher than 8 000 m. in the normally working pressurized cockpit the permissible difference of pressure is 0.28-0.32 kg/cm^2. If more, the pilot must regulate it by the air supplying cock.

2. "altitude" inside the cockpit must be approximately half of that outside.

124. When the cockpit canopy sweats while descending from high altitudes it is necessary to:

- check up whether the air supplying cock is open,
- check up whether the canopy is pressurized
- put the switch of the air temperature regulator in the position "Горячо" /hot/ and increase the temperature.

125. The cockpit is unsealed on the ground after the flight is over before cutting off the engines.

USE OF OXYGEN AND OXYGEN EQUIPMENT KMO-1 (КМО-1 М) IN FLIGHT

126. Before taxiing out to take off put on the oxygen mask.

127. The oxygen consumption in flight is checked by the pressure gauge and the work of the oxygen apparatus KP-30 (КР-34) by the IK-16 indicator.

When the pressure gauge reads below 30 kg/cm^2 descend

to an altitude of 4 000 m and lower where oxygen use can be neglected.

128. In case of insufficient oxygen supply for breathing it is necessary to switch to pure oxygen supply by putting the air suction handle on the panel DU-2 (DU-1)in the position"100% O_2" (see fig.12).

129. After high altitude flight one may take off the oxygen mask at an altitude of 2 000 metre or on the ground after landing.

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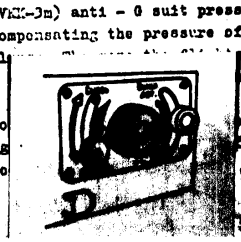
At an altitude o[illegible] oxygen supply during [illegible] automatically stoppo[illegible] suit drops.



132. To economize oxygen during a long duration flight in the unsealed cockpit at altitudes up to 10 000 metres it is necessary to manually switch OFF the oxygen supply by putting the oxygen supply cock in the position "ВЫКЛЮЧЕНО ОТ ВЫСОТЫ". Hereat bear in mind that in such a position of the cock the continuous oxygen supply cannot switch ON automatically therefore in case of a repeated climb to altitudes over 10 000 metres (with the pressure suit on) put the cock in the neutral position.

133. The KKO-1 (ККО-1м) operation in the unsealed cockpit at an altitude higher than 10 000 metres is checked by the pressure gauge 1 = 1000, which reads an excess of oxygen pressure in the mask in mm. of water column.

F L I G H T

WITH DROP TANKS

134. The aircraft is provided with two wing drop tanks of 760 lt or uniformed ones 400 lt each.

135. There is no difference between the take-off with suspended fueled tanks or without them but longer take-off run. While taking-off under maximum engine conditions with the flaps down to 15° the length of running increases by 250 metres.

136. In MIG-19 S flight with drop tanks and also in case of simultaneous suspension of drop tanks and two blocks of the ОФАО-57 k. rocket missiles do not exceed:

- indicated speed of 1000 k.p.h. (by the thick pointer) up to an altitude of 7 500 metres;
- true speed of 1 400 k.p.h. (by the thin pointer) from an altitude of 7 500 meares up;
- maximum operational overload with fueled tanks equal to 5;
- maximum operational overload with empty tanks equal to 6.

In this case the aircraft behaviour with or without suspended tanks is the same.

137. Long-time side-slipping and circle turns with side-slipping performed by the aircraft with fueled drop tanks are not recommended because of irregular fuel consumption from the drop tanks.

138. The land of the aircraft with empty suspended tanks does not differ from that without them.

139. The fuel consumption of fuel from the suspended tanks is checked by the green lamp shining with inscription "СИГНАЛИЗАЦИЯ ПОДВЕСНЫХ БАКОВ"

N O T E: If there is fuel in the drop tanks the lamp "СИГНАЛИЗАЦИЯ ПОДВЕСНЫХ БАКОВ" dies out at 6 000-7 000 R.P.M. of the engines.

140. If there is fuel in the drop tanks and the fuel indicator reads 1300 l. and less the lamp "СИГНАЛИЗАЦИЯ ПОДВЕСНЫХ БАКОВ" does not shine.

400 l. suspended tanks are allowed to drop at an indicated speed of within 350-1000 k.p.h. and 760 l. ones within 400-800 k.p.h.

. The suspended tanks are dropped by pressing the push button with the inscription "Аварийный сброс бомб,сброс баков" /Emergency bomb drop,tank drop/. These tanks may be dropped by pressing the tactical push-button on the control column (that push-button controls fire). But preliminarily put ON:

- circuit breaker "Кнопка оружия, ЭКП" /Common button,cannon-gun/;

- switches on the sight panel in the position "Бомбы" and "Ручное" /Bombs and Manual/;

- the switch "Тактический сброс, включено взрыв" /Tactical drop, explosion/.

The tanks having been dropped,their signal lamps located on the lower control panel of the instrument board must die out. Check visually tanks dropping.

When the suspended tanks are dropped with fuel the fuel consumption indicator overestimates the fuel reserve by a value of fuel remained in the dropped tanks. In this case use readings of the fuel indicator.

142. The landing of the overloaded aircraft (i.e. with suspended tanks,bombs and rocket missiles) with fuel remains of 1500 up to 2500 lt wants to be highly accurate, with the braking parachute being sure to be used. Gliding speed in this case must be 10-15 k.p.h. greater than usual. When the fuel remains before landing is more than 2 500 lt. it is necessary to drop the suspended tanks.

N O T E: In extreme case it is allowed to land with non-dropped tanks with fuel remains greater than

2 500 lt. After the landing check thoroughly the wheels,tyres, undercarriage and its joints.

N I G H T F L I G H T

143. The engine starting and taxiing out at night is performed as usual. Before taxiing regulate the lamps brightness and direction and switch ON the taxiing light.

144. The take-off technique is the same as at day time. Keep the direction by the light points along the runway. After take-off perform acceleration with gradual getting away from the ground, retract the undercarriage and proceed to climb.

145. There is no great difference between the flight at light night and the flight at day time. If the natural horizon is not seen, perform instrumental flight.

146. The third turn while approaching in for landing [redacted] is done a little bit farther than at day time. The aircraft must be recovered from the final turn at an altitude of 250-300 metres.

147. The landing at night on the runway illuminated by the searchlights is not so difficult; its performance is the same as in the day time.

148. The aircraft is equipped with landing [redacted] light which provides the pilot to make landing [redacted] ground searchlights.

While landing with flood-but without searchlights it is necessary to:

- put on the floodlight at an altitude of 100 metres having put its switch in the position "Посадочная"/Landing/,

- throttle the engines power down, 6 000 - 7 000 R.P.M. not earlier than at the point of flattening out by pulling the throttle lever smoothly back completely.

The landing without ground searchlights is more complicated and the pilot has to be more attentive and trained in night flights.

After the landing run put the floodlight switch in the position "Рулежная" /Taxiing/ and taxi using the taxiing light.

AIRCRAFT CONTROL IN FLIGHT

152. 10-15 minutes before firing prepare the gun-sight and radio range-finder that is, switch ON the circuit-breakers of /gun-sight heating/ "gun-sight" and "cone"/ /"Обогрев прицела","Прицел", "Конус"/. If the gun-sight and radio-finder are to be used right after the take-off their circuit breakers are switched ON on the ground.

153. Before using the gun-sight it is necessary to:

- switch the gun-sight ON / gyro/-"Гиро"

- set the gun-sight switch in the position of " radio " and check whether the " High voltage" lamp lights;

- check the gun-sight operation by making some slight turns, the movable graticule should shift opposite to the turn.

154. The guns are fired by pushing one button mounted on the control stick.

W A R N I N G: So as not to put instruments and aggregate units out of service it is permitted to fire at a time only from two guns. To fire in bursts from three guns is permitted only in combat actions.

155. In order to fire the guns it is necessary to:

- switch the required circuit-breaker /Guns/ "Пушки" (left,middle,right);

- reload the guns by pushing the each reload button in turns with intervals of not less than 2 sec.;

- check the readiness of the guns to fire by the red signal lamps in the counters of reserved cartridges;

- set the gun-sight switch in the position " НР-30" /NR-30/;

- switch the circuit-breaker /armament button/ /camera gun/ /"Кнопка оружия, ФКП"/.

- throw the trigger cover forward;

- perform aiming;

- press the trigger cover (if the circuit-breaker of the camera gun is switched ON, gun fire will be photocontrolled).

On finishing gun fire reload the guns.

156. In order to fire the rocket missiles it is necessary to:

- set the gun-sight switch in the position " РС " / RS /;

- switch the circuit-breaker " РС " ,

- switch the circuit-breaker /armament button, camera gun//"Кнопка вооружения, фотопулемет"/,

- throw the trigger cover forward;

- perform aiming;

- press the trigger cover.

7. [illegible] without drop tanks but with two blocks [illegible] -57 [illegible] do not exceed:

- indicated speed -1050 k.p.h. (on the thick [illegible] of the altitude of 7 500 m.,

- true speed -1 400 [illegible] k.p.h. (on the thin [illegible] the altitude of 7 500 m.,

- [illegible] overload equal to 6.

[illegible] 1. If the undercarriage is down [illegible] is prohibited.

2. At altitudes of at least 15 000 m. [illegible] engines rating do not fire the [illegible] may get [illegible].

If [illegible] to perform photo-shooting without firing [illegible] it is necessary to:

- make sure that the circuit-breakers of [illegible] photo are switched on;

- set the gun-sight switch in the position [illegible] or [illegible] -30 or [illegible] /,

- switch the circuit-breaker of /armament button, camera gun/ /"Кнопка вооружения, фотопулемет"/

- throw the trigger cover forward;

- perform aiming;

- press the trigger cover.

159. On finishing fire throw the trigger cover back, set the gun-sight on "Неподв" /fixed/, switch OFF the circuit-breakers of /"Прицел, обогрев прицела, РС, кнопка оружия, ФКП, пушки," / "gun-sight", "gun-sight heating", " missiles", " armament button", "camera gun", "guns", " zone".

160. When aiming and firing take into consideration the following:

- use the damping button when aiming in a turn to the target to save time of the angle of allowance;

- before approaching to the target set the range-finder outside base range approximately corresponding to the range of reliable engagement of the target by the radio range-finder;

- before opening fire it is necessary to keep the central point of the graticule in the centre of the target at least within 3-5 sec. to get a proper angle of allowance;

- when taking an aim the distance to the target may be determined by the range indicator (accuracy ± 100 -150 m.);

- aiming with the radio range-finder " zone " is done at altitudes above 2 000-2 500 m;

- in case of failure of the range-finder (the lamp " baggage " does not light) set the base of the target and put the range in the gun-sight due to the outside range-finder by hand.

N O T E : If the radio range-finder is in good repair the lamp " Engage " should shine in level flight up till the altitude of 2 000-2 500 m;

- when aiming at ground targets it is impossible to use the range-finder that is why set the range on the gun-sight due to the outside range-finder by hand;

- in case of failure the automatic operation (when in a turn the gratioule is immovable) set the gun-sight on " Fixed" and use the fixed gratioule for aiming;

- when firing the cartridges left are checked by the counters mounted on the armament panel.

161. For bombing it is necessary to:

- set the switch of the gun-sight in the position " Бомбы" /Bombs/;

- put ON the switch/"Тактический сброс, включено на взрыв"/. /Tactical drop,explosion/;

- switch the circuit-breaker "Кнопка оружия, СКП"/. /Armament button,camera gun/;

- throw the trigger cover forward;

- take aiming;

- press the trigger cover;

- check the dropping of the bombs by tell-tale lights dying out.

162. In case the tactical drop failed ,throw forward the safety hood " Emergency bombs dropping" and press the button then check the dropping of the bombs. On dropping the bombs put OFF the switch "Tactical drop, explosion" and the circuit -breaker "Armament button, camera gun".

W A R N I N G: When flying with bombsFHAB-500 andFHAB-250 do not exceed the true speed of 900 k.p.h. and overload 6 at any altitudes.

163. For immediate dropping the bombs on the friendly territory it is necessary to:

- make sure that the switch/"Тактический сброс включено на взрыв", /Tactical drop,explosion/ is switched OFF;

- throw forward the safety hood "Аварийный сброс бомб"/. /Emergency bombs drop/ and push the button.

164. For dropping the blocks of rocket missiles from the universal beams it is necessary to throw forward the hood "Аварийный сброс бомб, сброс баков"/. /Emergency bombs drop, tanks drop/ and push the button, both green signal lamps on the armament panel must go down at that.

165. For dropping the blocks of the rocket missiles from the suspended beams it is necessary to throw forward the hood/"[illegible]"/ /Emergency dropping of rocket missiles / on the left board and push the button.

166. For shooting by signal rockets it is necessary to turn on the switch /"Сигнальные ракеты"/. /Signal rockets/ and push the button of a required colour.

IV. P I L O T A G E

General Remarks.

167. The MiG-19 aircraft can perform all kinds of flight manoeuvres: simple, complicated ones and aerobatics. Negative overloads are permitted only when there are at least 1200 l. of fuel/emergency fuel lamp does not shine/ level flight for 15 sec. not more under maximum engine conditions and for less than 5 sec. under augmented conditions.

In flight with zero and negative overloads and also in climbing flight the signal lamps "no oil" may shine that is the oil pressure may drop lower than permitted. When the signal lamps "no oil" lights the engines may operate for not more than 15 sec. another negative overload within the time mentioned above is permitted not earlier than in 0,9 min. of level flight.

CAUTION: The transition of an aircraft to negative overloads or the other way around should not exceed 1-2 sec., as prolonged overloads near zero ones cause unnormal fuel supply of engines.

168. Here are main peculiarities of piloting on the MiG-19S aircraft:

- spatial orientation in vertical figures is rather difficult because of the great sweep-back of the wings;

- radii of vertical figures are extended because of high initial speeds;

- while piloting the ARU-2 (automatic stabilizer control) gives the opportunity to change the efforts on the control - stick like those on the elevators of the aircraft without hydro-amplifiers.

169. When piloting the aircraft balanced at an altitude of 6 000 m., indicated speed -800 k.p.h. there is no need to use the trimmer effect.

170. The pilot can use the artificial horizon as to check flight figures (particularly over the clouds and in bad visibility). This artificial horizon provides to:

- set exactly necessary banks, dive angles, tail heaviness and check them;

- check the coordination of movements of figures by controls;

- determine the aircraft attitude in space relative to the natural horizon and recover it from this attitude;

- determine errors (of banks, side-slipping, uncoordinated actions of controls) particularly of vertical figures.

171. When manoeuvring at average altitudes with great overloads and particularly at great altitudes with comparatively small overloads (about 3,5) there can be phenomena on the aircraft typical for stalling angles (first shaking then swinging from wing to wing).

In this case stop pulling the control-stick when shaking and swinging disappear.

172. To quickly speed the aircraft up or down in making one figure after another it is necessary to increase or decrease engine revolutions not in level flight but when it is tail or nose heavy respectively, the air brakes being applied.

For gaining momentum increase the engines revolutions on diving at an angle of 30°.

173. When mastering the MiG-19 S aircraft perform flight manoevres at altitudes of within 4000 - 10 000 m.

Going into Nesterov's loop and half-loop is performed at altitudes of under 7 000 m. at an indicated speed of 600-650 k.p.h.

C I R C U I T T U R N

174. When performing circle turns the aircraft is stable at all the altitudes and speeds. There is no difference between performing right or left circle turn.

175. Before coming into a circle turn set the required speed and then bring the aircraft into the circle turn by stick and rudder at the same time increasing the thrust up to desired rate (nominal, maximum, augmented). The circle turn performance is checked by turn and slip indicator, speed indicator, altimeter and variometer.

Maintain the required speed by changing the bank and overload.

The aircraft is brought out of the circle turn by stick and rudder, the thrust being moderated with a view of being in straight and level without changing the speed of flight.

176. In case of overpulling the control-stick the aircraft will stable then swing from wing to wing and may even fall

into spin, if the stick overpulled too much or speed reduced. In case of aircraft shaking, it is necessary to push the stick just a little until the shaking stops.

177. When performing circle turns and spirals at a speed corresponding to M=1,25 and more at altitudes over 10 000 m. a complete pulling the control-stick back is possible; in this case the aircraft does not shake, the speed decreases and the control-stick remains extremely back, the aircraft shakes at a speed of M=1,25 and at a speed of M=1,15-1,2 the aircraft quickly increases its rate of turn and takes great angles of attack because of increase of tail-plane effect.

In this case it is necessary to decrease pulling the control stick. At a speed in a circle turn corresponding to M<1 the aircraft shakes when the stick is pulled even slightly.

178. Table 4 shows circle-turns most advantageous from the point of view of time.

T a b l e 4.

parameter	engines rating		
	afterburner	maximum	
	H =1200 m.	H = 12000 m.	H=5 000 m.
indicated speed in k.p.h.	500 - 550	400 - 450	550 - 650
time of circle-turn in sec.	85	120 - 130	40 - 45
radius of circle turn in m.	3 700	4600-4800	1200-1700
o v e r l o a d	2,4	1,5 - 1,6	3,5 - 3,8

179. Performance of the circle turns with and without drop tanks is the same.

180. Figures of eight in level flight are performed like circle turns. The circle-turn of one direction is shifted to the circle turn of another direction by continuous and coordinated movement of the control-stick and pedals without moving the engine control lever, speed and altitude being constant in the course of the whole figure.

C L I M B I N G T U R N

181. Climbing turn may be performed in nominal, maximum or afterburner engine ratings at speeds not exceeding maximum speeds of level flight.

While making a turn the aircraft gains 4 000 -6 000 m. of altitude.

182. Before coming into the climbing turn increase the revolutions of engine up to 11150 R.P.M., switch on "[illegible]" /Maximal/ or "Gorcam" /afterburner/ gain a required speed and make the aircraft tail heavy by smoothly pulling the control stick back and towards the turn, with the rudder being pressed slightly towards the [illegible] spiral climb with a bank of 5°-10° at first and 65-70°, no more, at 2/3 of the turn.

When the aircraft has turned for 140-150° it is necessary to gradually recover the aircraft by opposite stick and rudder with a view of leveling off at 150° sharp and indicated speed of 350 k.p.h.

183. The climbing turn with the minimum period of time is performed in the following way: arrived at a required speed, put on a 15-20° bank and make the first half of a

side loop. At the top of the turn (corresponding to 160 -165° to the original path of flight) when the aircraft is almost turned over and its nose is 10-15° over the horizon, recover the aircraft by opposite stick and rudder.

When the aircraft takes the level flight all controls in neutral position. The speed of recovery must be not less than 350 k.p.h. on the instrument.

184. If the control-stick is overpulled in the climbing turn the aircraft begins vibrating and swinging from wing to wing which means it assumes stalling angles of attack and stalling speed. In this case step pulling and [illegible] the control-stick until vibration stops.

Half - Roll

185. The half roll may be performed at altitudes of 4 000 - 17 000 metres. The initial indicated speed of the half roll is:

at altitudes of 4 000-6 000 - 400-500 k.p.h.
" - " - 6 000-10 000 -400-600 " - "
" - " - 12 000-14 000 -400-500 " - "
" - " - 15 000-17 000 -350-400 " - "

It is allowed to perform half rolls at the given altitudes and speeds with the air brakes ON or OFF. At the beginning of training the flying personnel in the zone, the half roll should be performed from altitudes of 6 000-10 000 m. The altitude drop, in this case, is equal to 3 500 -4 500 m.

186. In level flight before entering the half roll set a speed, having the aircraft nose up 10-15° then apply stick and rudder toward the turn so as to turn it over within 2-3 sec., R.P.M. being cut up to idle ones at that.

When the aircraft is in the position of wheels-up stop its further rolling by co-ordinated stick and rudder and without fixing the aircraft in this position pull the control stick smoothly back so as to level OFF from dive at an indicated speed of 700 k.p.h.

While recovering from the dive the stick is brought all the way back.

187. While recovering from the dive pull the stick neither too fast nor too slowly.

The control stick overpulled, the aircraft begins vibrating, then swinging from wing to wing. In this case it is necessary to make the aircraft stop vibrating by pulling the stick more gently. This done, recover the aircraft from dive and level OFF. If the recovery from dive is followed by slight vibration (especially at high altitudes) the aircraft loses less altitude, has less overload and acceleration.

Slow recovery from dive is followed by great speed-up and loss of altitude. In this case pull the stick more energetically but not overpull it.

188. The half roll is initiated at maximum level flight speed and nominal and maximum engine power from the altitude of 8 000-10 000 metres only with the brakes put ON and from the altitude of 10 000 -17 000 metres with the brakes ON or OFF.

The aircraft is brought at maximum level flight speed and augmented engine conditions from the altitude of 12 000 -17 000 metres with the air brakes ON only.

189 The half loop at maximum level flight speed is performed at an altitude of at least 8 000 m, by speeding the aircraft up fully and then by putting ON the air brakes switch on the right engine control lever.

The air brakes light shined, make half a loop by stick and rudder. While turning over, pull the throttle back from "Номинал" /Nominal/, "Максимал" /Maximal/ or "Форсаж" /Afterburner/ position up till "Малый газ" /Idle rating/ position.

At a moment the aircraft is upside down the stick is clear back until the aircraft is brought into dive and level flight.

190. Peculiarities of half roll performance:

- long-time overloads (especially at ltitudes less than 12 000 m.),

- onergetic pulling of the stick back at the moment between " wheels-up" position and dive position (at λ=0.95-1.05) results in aircraft vibration at altitudes of 10 000 m. and more.

R O L L

191. It is permitted to perform both snap and slow aileron rolls with "MIG-19 S" aircraft. The snap aileron roll in level flight is performed by setting first 600-700 k.p.h. on the instrument, then pulling the plane up into a 10-15° climb. This position fixed, make the plane rotate about its longitudinal axis by gently pushing the stick toward rotation.
Arrived at a 75-80° bank, the stick is slightly pushed forward, the rotation is maintained, to prevent the plane from turning and dipping its nose when it is upside down. 40-30° before straight and level check your position with the horizon by pulling the stick slightly back. While recovering from roll push the stick gently against rotation, to stop it, and then in the neutral position. It takes 4-5 seconds to make a snap aileron roll.

192. The snap aileron roll at high speed is initiated by pulling the aircraft up into 20-30° climb, then it is performed in the same way as rolls at 600-700 k.p.h. speed.

It takes the aircraft more time to roll completely over at high speed because of less aileron effectiveness.

193. It takes 5-8 sec. to make a slow aileron roll. While performing this kind of roll the aircraft assumes various angles of attack and loads both positive and negative.
The slow roll is performed by getting 600-700 k.p.h. in level flight, pulling the nose up at 15-20° / this position is fixed/ and rotating the aircraft about its longitudinal axis with stick and rudder. Arrived at a 45° bank, push gently the stick forward to prevent the plane from turning with the opposite rudder being pressed to prevent the aircraft from dropping its nose.
The aircraft turned for 90°, go on with pushing the stick forward so as to have the aircraft nose 10-15° over the horizon when it is in the position "wheels-up" with the opposite rudder being eased. Put the pedals neutral when the plane is turned over.
Arrived at 225°, keep the aircraft nose from dipping by pressing the rudder toward rotation/maximum pressure has to be at 90° bank/. Then it is necessary to release this pressure and put the pedals in neutral position when the aircraft recovered from the roll.
When the aircraft turned for 270°, push the stick slowly forward so as not to drop the nose of the plane. At the end of roll bring opposite controls and after aircraft recovery put them neutral.

194. It is allowed to perform level flight rolls as well as climbing and gliding ones at an indicated [illegible] of more than 400 k.p.h.

195. Double(multiple) level flight rolls are nothing but two or more rolls performed one after another. It is permitted to perform both snap and slow aileron double(multiple) level flight rolls.

At middle altitudes the aircraft is brought into a double level flight roll at a speed of over 600-700 k.p.h. It is performed in the same way as single rolls.

NESTEROV'S LOOP

196. Perform loop at altitudes not more than 7000m. with nominal, maximum or afterburner engine ratings. An indicated entering speed should not be below 820-850 k.p.h..

197. Before going into the loop get sufficient flying speed and pull the nose up so as to get the overload of 4.5-5,5 at an angle of pitch 30-40°, the stick being pulled all the way back.

The stick is pulled back with a view of keeping the rate of turn approximately constant and maintaining an indicated speed of over 350 k.p.h. and overload of 1.5 when going over the top of the loop. The loop has to be completed in the vertical plane without banks.

On the top of the loop when the nose of the aircraft cuts the horizon,gently close the throttles,go into dive and level off as in the half roll.

The loop requires great radius and consequantly much time to perform it.

198. When the aircraft nose is skyward the stick is brought gently but firmly all the way back. Do not be afraid of overpulling because the stalling moment will be proceeded by vibrations and rolling.

Slow (uncoordinated) pulling may lead to a drop in speed and "panokaking". As the loop progresses check the overload on the indicator.

S I D E - L O O P

199. In case the pilot,before entering the loop,sets a bank of 10-45° and starts the figure,keeping the same bank, the aircraft will perform a closed curve on a slanted plane to the horizon. The figure of this kind is called the side loop.

200. The procedure of performing the side loop is the same as that of the Nesterov's. The only difference is that the pilot should be much more careful in operating the controls. He pays his major attention as to keep the bank during the whole processs of the figure and especially when he is on the top of the loop and going over it. When in an inverted attitude (the pilot observes ground and horizon the other way about) one should determine and keep the bank of the aircraft relative to the horizon. E.G., - if there is a left bank the left wing tip will be lowered the right one elevated.

After the aircraft starts diving the pilot should apply opposite pedal to keep the direction at ease. When the aircraft reaches the line of horizon reduce bank and gradually put the pedals neutral.

When performing the second part of the side loop, avoid rolling, especially towards the bank, because it may result in falling into a steep spiral.

201. At the beginning of training the side loop should be performed at a bank of not more than 20°. Altitudes and speeds of entering the side loop should be those as prescribed to the Nesterov's loop. In case of hesitation as to the right way of performing the second part of the side loop one should put OFF the bank and finish the figure by the Nesterov's loop.

NESTEROV'S HALF LOOP

202. The procedure of the first part of the figure is similar to that of the Nesterov's loop.

203. Enter the figure at a speed of not less than 850-870 k.p.h. at an altitude of not more than 7000 m. under nominal, maximum or afterburner ratings of the engines. If the figure is commenced at an altitude of 5000m. the aircraft will gain 4000m. of height.

204. When in an inverted attitude at the upper point of the half loop (speed should be not less than 370 k.p.h.), apply a smooth effort on the stick and the pedal to the side of the roll for turning the aircraft about the longitudinal axis by 180° (make a half roll). The operation with the controls should provide a complete roll for 3-4 sec.

When the aircraft has been turned about the longitudinal axis by 90°, the pilot, going on pressing the stick to the side of rolling, should at the same time apply a slight push on the stick keeping the direction

and decreasing the angle of attack in order to avoid the drop in speed. At the moment the aircraft assumes the level flight attitude stop rolling and decrease the engines speed.

205. If the speed of the aircraft at the upper point of the half loop is below 370 k.p.h. the figure should be completed by the loop because an extra deflection of control surfaces at a low speed may result in falling into a spin.

Z O O M

206. The zoom may be performed at nominal, maximum or afterburner ratings of the engines at an entering speed up to the maximum admissible value for a given altitude. The zoom is permitted with any angle up to 80°.

207. Come out of the zoom with a turn. For this purpose put ON bank and then apply coordinatively the stick and the pedal to turn the aircraft with the noze down. The speed of recovery should be not less than 450-500 k.p.h. at climb angles of 60-80° or 400-450 k.p.h. at an angle of 60°.

HALF ROLL ON ZOOM

208. The half roll on zoom is performed at altitudes of 4000-12 000 m. The initial speed should be within the range of 800 k.p.h. up to the maximum admissible value of level flight.

209. For training purposes the half roll should be practiced from 5000-10 000 m. of altitude at a speed of entering the zoom 600-650 k.p.h. The half roll on zoom performed from heights below 5000 m. and above 10 000 m. is permitted for pilots who have perfectly mastered the aerobatics of the given aircraft.

210. Before entering the figure the pilot should gain a given speed value in level flight at the nominal rating of the engines and apply a slight pull on the stick thus climbing the nose skyward with the angle of climb depending upon the excess of speed, i.e. - at an entering speed of 600-650 k.p.h. the angle of climb should be 40-45°.

At reaching 500-450 k.p.h. on the zoom (at an entering speed of 650 k.p.h.) turn the aircraft smoothly over about its longitudinal axis by 180° (make the half roll) and, watching the speed, apply a pull on the stick to assume an inverted attitude at a speed of 400 k.p.h..

At the moment the nose of the aircraft cuts the horizon the engines speed should be reduced down to the slow running conditions and the aircraft be driven into dive with the further levelling by pulling the stick back (make a second half of the Nesterov's loop).

211. In case the zoom was entered at a speed close to the maximum admissible value at an angle of climb within 60-80° the pilot should turn the aircraft about its longitudinal axis by 180° at a speed of 600-500 k.p.h. He should also assume an inverted attitude with a view to getting a speed of 370 k.p.h. at the upper rolling point of the loop with the nose of the aircraft resting on the visual line of horizon.

VERTICAL EIGHT

212. The vertical eight is a continuous combination of two Nesterov's loops. The loops are connected with each other by turns of the aircraft about its longitudinal axis by 180° on verticals up or down.

213. In vertical eight with the turn of the aircraft about its longitudinal axis on a rised vertical the speed of entering the either loop should be above the Nesterov's loop value by 40-50 k.p.h.

The turn of the aircraft about the longitudinal axis should be performed at the end of the first quarter of either loop,e.i. when the aircraft is in climbing attitude at an angle of 40-90°.

214. In vertical eight with the turn of the aircraft about its longitudinal axis on a descending vertical the speed of entering either loop should be of a standard value. The turn of the aircraft about its longitudinal axis should be performed at the end of the third quarter of either loop, i.e. when the aircraft is in steep descending.

DOUBLE RISED TURN

215. The double rised turn is a continuous combination of the first phase of the combat turn with the rised half roll to the same side completed by the second phase of the combat turn to the opposite side.

216. The double rised turn is permitted at any altitude and speed up to the maximum admissible value.

217. At a given altitude gain prescribed speed, by operating the controls coordinatively to start the combat turn at an initial bank of 5-15°.

At the [illegible] the aircraft is turned by 90° from the initial [illegible] stop the angular motion of the aircraft without [illegible] the angle of climb. Then operate the stick and pedals coordinatively to perform the rised half roll to the side of bank.

As soon as the reversed turn of 50-60° is reached, stop turning and continue the second phase of the combat turn in a new direction by 90°. Come out of the second phase of the combat turn at a speed of not less than 350 k.p.h.

ROLLS OF THE AIRCRAFT ABOUT THE LONGITUDINAL AXIS BY 90 AND 180° ON RISED ASCENDING VERTICALS

218. Roll of the aircraft about its longitudinal axis on a rised or descending verticals are permitted at any speed up to the maximum and at a height safe enough from the point of view of pulling out of dive.

219. The practice in rolls about the longitudinal axis should be started from training in rolls by 180° to on descending verticals first at angles of dive equal 60-70° and then on vertical diving. When you are sure that rolls on descending are mastered, you may begin training in rolls on rised verticals.

When training in rolls on descending you may stick to your experience in diving to the half roll or the second part of the Nesterov's loop, while on rised verticals- after zoom, loops or rolls on the top under standard entering speed etc. As the training progresses, perform rolls on verticals in combination with other aerobatic figures at greater speeds and higher altitudes.

220. The roll of the aircraft in diving is performed by applying a short push on the stick, fixing the aircraft at a given angle of diving, then turning the aircraft about its longitudinal axis by 180° or 90° with stick and pedals. Stop rolling the aircraft before reaching a chosen reference point by 10-15° and pull out.

221. The procedure of rolling the aircraft about its longitudinal axis by 180° and 90° under climb angles of 90° is similar to that in diving. Rolls by 90° may be perfectly performed on verticals at an angle of climb equal to 90°. The initial speed should be above 750 k.p.h.. A 180 or 90° roll may be followed by any figure or mode of flight. At climb angles under 60-70° the pilot should use outstanding ground reference points seen well on the horizon to perform accurate rolls by 180-90°. At climb angles above 60-70° the pilot should use the sun or separate clouds (if possible) for reference. He should also gain the experience in determining angles of roll according to the momentum of rolling judging by the time.

D I V I N G

222. The Mig-19S aircraft is permitted to a durable vertical dive with the air brakes on from an altitude of 10000.

or above this number at an entering speed up to the maximum level flight value under afterburner conditions.

223. In case of vertical diving with the air brakes OFF an entering speed should not be above the maximum level flight value under afterburner conditions.

224. Start vertical diving with the half roll. Before entering the half roll the engine controls are throttled down and kept in this position until pulling out of dive.

225. Start coming out of dive at an altitude before 8000 m. with the air brakes on and before 11000 m. with the air brakes OFF.

226. Drop in height at coming out with the air brakes on equals 4000 m. and 6000 m. with the air brakes OFF, overloading being as 4,5-5,5.

227. It proves easy to keep the aircraft in vertical diving. While on straight diving path the pilot is able to roll the aircraft about the longitudinal axis.

228. Diving at angles of 60-70° is permitted with the air brakes ON or OFF under any condition of the engines. Limitations in speed at recovery should be strictly observed. Coming out of dive should be completed at an altitude of at least 1000 m. over the ground.

S P I R A L

229. The spiral at a bank of 45° is performed on slow running conditions of the engines at speeds of 500-550 k.p.h. Before entering the spiral you should start gliding at a speed of 500-550 k.p.h. and then, with coordinative operations of the control stick and pedals, put the aircraft into spiral.

230. Decrease or increase in speed on the spiral should be obtained by a relative change of the angle between the longitudinal axis of the aircraft and the horizon line (i.e. elevating or lowering of the aircraft nose). Aerobatic technique of the spiral is similar to that of the circle turn. The drop in height one spire equals 1500-1600 m. at an entering height of 5000m.

231. The aircraft is recovered from spiral by opposite stick and rudder and by opening the throttles when or before leveling off.

232. When coming out of the steep spiral at an angle of 30° to the horizon line you should at first reduce bank and then pull out.

233. In case the undercarriage and flaps are down the spiral should be performed at increased R.P.M. and an indicated air speed of 450 k.p.h. with rate of descent being more than 25-30 m/sec.

S I D E S L I P

234. The side slip with the undercarriage and flaps down should be performed at an indicated air speed of 320-350 k.p.h. under slow running conditions of the engines.

235. The aircraft is brought into side slip by turning it for 10-15° to the opposite side, putting on a bank with the opposite rudder being pushed to prevent the aircraft from turning. The aircraft is steady in side slip at a bank not more then 12° under full deflection of the pedal. It is impossible to obtain a steep bank in a coordinative side slip because the rudder is inefective,

236. The side slip is recovered first by putting off the bank then by pushing opposite rudder and setting a proper angle of glide.

In case the undercarriage and flaps are up you should perform the side slip at an indicated air speed of 350 k.p.h.

S P I N

237. The MIG-19S aircraft falls into spin as a result of topic errors in pilotage technique.

Aircraft behaviour at stalling speeds and at falling into spin.

238. When the aircraft with the undercarriage and flaps up within idle-nominal engines conditions slows its speed down to 280 k.p.h. there may occur a slight warning vibrations accompanied by lateral oscilations. If the speed drops down the vibrations go up.

At a speed of 220-220 k.p.h. and a pitch angle of 10-15° the aircraft rolls slightly and lowers the nose. If in the process of decreasing the speed the pilot applied a gradual pull on the stick then in most cases at an angle of pitch over 15° the aircraft dips its nose with the bank to the left side. In case the pilot applies an abrupt pull on the stick the aircraft drops its nose to the right side. If in this case the pilot goes on to keep the stick in the clear back position the aircraft falls into left or right spin even though its rudder and ailerons are in neutral positions.

A push on the stick applied at the moment the aircraft is lowering its nose results in a shallow glide to the left or right side with or without bank. The control of the aircraft regains and it comes out of a shallow glide easily at a speed of 250-270 k.p.h.. It does not make much difference between the aircraft behaviour with the undercarriage and flaps down or up at a stalling speed. The aircraft nose goes down at a speed of 220-240 k.p.h. at most.

239. The aircraft may fall into a spin at a speed more than stalling one. For example, the aircraft falls into spin at a speed of 250-260 k.p.h. when the stick is clear back but a rudder is applied. As a rule the aircraft goes into a spin of the pushed rudder, but it has more tendency to the left side than to the right one.

The aircraft goes abruptly into left or right spin when the stick is overpulled straight back in the circle turn and the aircraft begins vibrating.

If the stick is overpulled in the right circle turn, the aircraft vibrates hard, swings from wing to wing and falls into left or right spin.

If the stick is overpulled in the Nesterov's loop or zooming and is held in this position until the speed stalls down to 280-250 k.p.h. on the instrument the aircraft may fall into inverted spin or inverted spiral.

If the aircraft drops its speed in the position upside down it may go into inverted speed or inverted spiral in case full stick is pushed forward at an indicated speed of 280-250 k.p.h..

In all cases the aircraft begins vibrating heavily both in level and aerobatics it is necessary to stop pulling the stick back or even push it forward a little bit to cut vibrations and avoid spinning.

The stick applied opposite to the spin assists its entry, applied towards the spin resists it.

Plenty of aileron (at least 10°) applied towards the left spin may bring the aircraft over to the right spin but applied towards the right spin, it leads as a rule to the left spin.

AIRCRAFT BEHAVIOUR IN SPIN

240. The aircraft makes first two-four spins on the [illegible] trajectory, its nose being brought up over the [illegible] at the end of each spin then dropped down to a [illegible] angle of dive. After two-four spires the spin is stable as a rule.

Left spin is more energetic than the right one and its rate of turn is more stable. The aircraft pitch to the [illegible] both in the left and right stable spin is equal on the average to 40-50° ± 15-20°.

It takes 3.0-4.5 sec. to make one left spin, the aircraft loses 500 m. at that. It takes 4-6 sec. to make one right spin, the aircraft loses 400-600 m. at that.

While spinning the rudder has a tendency to be neutral especially at the moment the plane slows down its rate of turn (pressure on the pedals varies).

The pilot feels this difference of pressure especially on the right spin. It is rather easy to keep the rudder pressed. There is nothing particularly difficult about pulling and keeping the stick back in the spin, the efforts equal 3-5 kg.

Extension of the flaps has not much influence on entry into or recovery from the spin.

Overloads in the spin are not great and the pilot is practically not aware of them.

Recovery from spin

241. Procedure of normal spin recovery:

- abruptly and fully push opposite rudder and then after 3/4 of the spin push full stick forward, with ailerons being neutral all the time;

- when the aircraft stopped turning, put the rudder in neutral position and pull the stick respectively back so as to avoid negative angles of incidence when gaining momentum.

If you have pulled the stick too much on recovery at a speed of under [illegible]-350 k.p.h. you may fall into a spin once again.

If you pull the stick prematurely(the aircraft is still spinning, the pitch angle is almost vertical) the aircraft will spin even faster.

The stick being pushed vigorously and fully forward, the aircraft does not take negative angles of attack: it only dives straight down along the vertical.

Ailerons play a great role on recovery from spin. If they are applied opposite to the spin for 10-15° (i.e. the stick being pushed forward and left when recovering from the right spin and forward and right when recovering from the left spin) the aircraft would not recover.

Opposite ailerons being applied gently may lead to too late recovery. Ailerons pushed towards the spin assist the aircraft to come out of it.

The MIG-19 aircraft loses 2500-3000 m. of altitude when recovered since the time you have pushed the stick forward.

If the aircraft does not recover, do the following:

- make sure that the opposite controls are pushed correctly and fully;
- if pushed in a wrong way, put them opposite the spin, if the aircraft does not recover at the controls being applied properly, give ailerons toward the spin(bring the stick towards aircraft rotation),
- the aircraft stopped spinning, put the ailerons and rudder neutral and pull out of dive.

Recovery from normal spin.

N.B., If you fell into a spin unintentionally under simple meteorological conditions it is necessary to drive the plane into dive then level off by pressing opposite rudder and pushing the stick forward.

If you have failed to avoid falling, you should :

- throttle the engines right back until "Малый газ" /idle running/ conditions;
- determine the direction of spinning;
- apply full controls towards the spin and put the ailerons neutral,
- recover the aircraft from spin in the way mentioned above.

If you have fallen into a spin under complicated weather conditions when the ground is out of your sight and you have plenty of altitude, come out of spin by the navigation instruments in the following way:

a) suppose it is a fall into spin determined by sharp drop in speed (due to speed indicator), hard vibration and declination of the electric turn and bank indicator pointer towards the fall, it is necessary to push the stick well forward at once, throttle back up to "Малый газ" /idle running/ position and recover the aircraft from spiral after it stopped vibrating and began gaining momentum(due to speed indicator). The aircraft is recovered by opposite ailerons (i.e. applied opposite to where the electric turn and bank indicator declines. This done, pull out of dive and level off due to the artificial horizon,speed indicator and variometer,adjust the gyro compass when finished.

b) Suppose it is a spin determined by the declination of the electric turn and bank indicator pointer fully towards the spin (in case of left spin this pointer goes extremely left and rests there until the spin stops, in case of right spin this pointer shifts from one side to another and only then it assumes extremely right position) and by the declination of the speed indicator pointer within the range of slow speed, it is necessary to:

- close the throttles until "Малый газ" /idle running/ position;
- determine the direction of spinning (by the electric turn and bank indicator), put the controls toward the spin, ailerons - neutral;
- in 2-3 sec. press opposite rudder (opposite to where the electric turn and bank indicator pointer inclines) in 3-4 sec after this done, push the stick fully forward;
- hold the controls in this position until the electric turn and bank indicator starts to go neutral

and the speed indicator reads uniform acceleration, after that put the rudder neutral, softly pull out of dive and level off due to artificial horizon, speed indicator and [illegible] the gyro compass when finished.

If the aircraft has not come out of spin down to 4000-3000 m. the pilot bailsout.

Inverted spin and inverted spiral.

243. The Mig-19S aircraft may involuntarily go into inverted spin or spiral because of the pilot's flagrant errors in mode of flight.

The inverted speed in comparison with a normal one is particular about its greater and rate of turn, more stable.

Its pitch angle to the horizon is 140-150°, and it takes 3,0-3,5 sec to make one spire.

When spirals down the pilot is quite aware of overloads on stick and rudder. It is rather difficult to press the pedal toward the spin and push the stick forward because of negative overloads and because the pilot is in an unnatural position.

When inverted, the pilot does not see the natural horizon.

Because of all these factors mentioned above it is rather difficult for the pilot to determine his attitude in space and direction of spinning. When inverted the aircraft turns to where the rudder is pushed.

Aircraft Behaviour on Inverted Spiral.

244. The inverted spiral differs from the inverted spin by speed acceleration and greater negative overloads which grow higher with speed.

Recovery from Inverted Spin and Inverted Spiral.

245. To recover the aircraft from inverted spin and inverted spiral it is necessary to:

- fully push opposite rudder and pull the stick well back;
- put the pedals neutral when stopped rotating and recover from negative dive.

The aircraft is sure to come out of inverted spin and inverted spiral after one spire, not more.

If the pilot is not capable of determining the direction of rotation it is necessary to put rudder and ailerons neutral and pull the stick well back. After the aircraft ceased turning pull out of negative dive.

If the rudder is put neutral not accurately, the aircraft may be late with recovery for 2-2.5 spires.

In case the aircraft has gone unintentionally into inverted spin or inverted spiral it is necessary to:

- close down the throttles,
- determine the direction of rotation and recover by way mentioned above.

If the pilot does not come out of a normal or inverted spin at an altitude down to 3000m, he should leave the plane.

SPIN EMERGENCIES

246. At an altitude of up to 13 000 m., on spin, there may be casual switch-off of engines and above 13 000 m.,as a rule, both engines switch off casually.

There is no practical difference between the spin and its recovery with switched of engines (engine) and the spin and its recovery with slow running engines.

The engines switched off casually on spin are sure to be relighted according to the Instruction.

On spin the P A-I compass operates improperly. Therefore after spin it is prohibited to go into clouds until operation of this instrument is all right. As a rule, its operation is restored in 4-6 min.

247. The aircraft whose stabilizer happened to be controlled electrically (the stick moves clear forward and back very slowly though great efforts are applied on it) is recovered from spin in the following way:

- push opposite rudder fully;
- push the stick well forward as vigorously as possible;
- push the ailerons towards the spin,if the aircraft has not stopped rotating;
- put rudder and ailerons neutral and come out of dive when finished rotating.

247 a. When falling into spin at 18 000-19 000 m the aircraft makes spires jerkily,its nose pitching now down, now up.

Sometimes,especially on the right spin, the aircraft rolls in and out like "leaf" tending to spin over. When falling into spin at high altitudes the aircraft goes on spinning like that at middle altitudes.

Thus, the nature of the spin depends on an altitude the aircraft fell at. The peculiarity of falling into spin at a supersonic speed is its energetic rolling and overload changing from 0 to 4.5.

247 b. To recover the aircraft from high altitude spin, it is necessary to put stick and rudder neutral. The aircraft recovers in the case in 5-7 sec (after making one spire,not more).

If the stick and rudder are put neutral but the aircraft assumed a spin of opposite direction, let the controls stay as they are and aircraft will recover within the time mentioned above.

When recovering from high-altitude spin in a standard manner(full opposite pedal and forward stick), the aircraft, as a rule,turns over or assumes the spin of opposite direction.

VII. FLIGHT FINISH

Preparation for landing.

286. When approaching to the airfield check:

- the circuit breakers of "пушки" /Guns/ "Р[illegible] /rocket missiles/ and "Кнопка оружия, ФКП " /armament button, camera gun/ if it was used, are OFF;
- gun trigger button in safety position;
- pressure in the main pneumatic system;
- the circuit breaker of "Автомат тормозов колес" /automatic wheel brake/ -ON.

287. Set a flight speed of 500 k.p.h. by cutting engine speed and putting on the air brakes if necessary and enter the circuit of the field at an altitude of 500 m.

Undercarriage extension.

288. The undercarriage should be lowered on the downwind leg before the third turn at a speed of not more than 500 k.p.h. by shifting the undercarriage control lever down in "Выпущено" /down/ position.

289. Undercarriage extension is checked by three green lights glowing on the landing panel, full extension of the pop-up indicators and pressure in the hydraulic system increased to 135± 7 kg/cm^2. The undercarriage control lever should be left in the position "Выпущено " /down/.

The landing gears lowered harness the shoulder straps.

Landing calculation

290. The level flight beginning from undercarriage extension up till key position is performed at a 450 k.p.h. speed.

291. Before the final turn put the flaps first in the take-off position, then in the landing position and check it by tell-tale lights. The light "Закрылки выпущены" /flaps down/ on the landing panel as well as light "Посадка" /landing/ on the flap board glow.

When releasing the flaps the tail becomes a little bit heavy. This tail-heaviness is easily neutralized by pushing the stick forward.

C A U T I O N : In case of quick banking of the airoraft after releasing the flaps retract them immediately.

292. Glide on the base leg after the flaps are in the landing position at a speed of 400 k.p.h.

293. Prior to the final turn, check (Fig.13) that the APY-2 automatic stabilizer control indicator needle has changed the long arm (it is in the extremely left position, the light glows). If the needle has not passed to "Большое плечо" /long arm/ and the light does not shine it is necessary to set the switch "APY-2" in "Ручное" /manual/ position and put the APY-2 on the long arm "Большое плечо" position by the arm switch.

N O T I C E : 1. " The long arm" light may not glow at a speed of flight of 410-450 k.p.h.

2. When it is impossible to put the APY-2 in the /long arm/ "Большое пле-/ position (in case of the failure of

automatic device or its chaines) make landing with the APY-2 in whatever position it is. The landing with the APY-2 in the short arm"position is characterised by small margin for stabilizer deflection, great efforts on the control stick and higher landing speeds. Therefore the glide speed must be increased by 20 k.p.h. Angle of glide should be shallower.

Fig.13. APY (automatic stabilizer control "long arm" light glowing should be checked before the final turn.

294. If the tell-tale light " Выпусти массои"/undercarriage down/ on the landing panel has shined, it means that the undercarriage is not extended or extended not completely; in this case the pilot should make another circuit flight, extend the undercarriage completely and then make landing.

295. The final turn is performed at a speed above 380 k.p.h. with the R.P.M. well increased. The recovery from the final turn must be completed at an altitude of at least 250 metres.

296. After the final turn decrease the speed with a view to getting it equal to 300-310 k.p.h. prior to flattening-out. Glide at an angle which allows moderate open-up. Correct the landing calculation by changing the R.P.M. or putting the brakes ON. Specifying of the landing calculation by side slipping is of almost no use. On the final approach the aircraft deminishes its speed rather slowly and has a shallow angle of glide. The aircraft nose at that [redacted] nearly cuts the horizon line.

297. Another circuit flight is possible from any altitude down to flattening height. Since the pilot decided to go round again, he must increase engine R.P.M. up to rated (or maximum) engine speed.

At an air speed of 350-370 k.p.h. bring the aircraft into climb and retract the landing gears. At an altitude of not less than 100 m. and speed up to 300 k.p.h. put the flaps up and make another complete circuit of the field.

L a n d i n g

298. From the altitude of 20-30 m till the flattening-out look down to the ground forward left at an angle of 15-20°, your eyes straying once or twice to the A.S.I.

299. At an altitude of 6-7 m. press the stick slightly back, stop the aircraft descent at an altitude of 1 metre, not more. This done, close the throttles back and proceed levelling OFF.

300. While floating you apply suitable stick back so as to let the aircraft touch down the ground on [redacted] points (i.e. the stick is pulled back completely), [redacted]. Normal landing speed with flaps down is 235 k.p.h..

If the stick is pulled back not enough the speed of touching down and landing run will be greater.

301. When floating keep [redacted] looking at the ground (15-20° to the left and 30-40 m. forward) because, if not, you will make mistakes of judging a distance to the ground; looking nearer results in ballooning, looking farther - in high landing speed with the nose wheel raised not enough.

Looking at the ground through the front bullet-resistant glass complicates estimation of the height to the ground and is occasioned by topic faults on landing.

302. Having touched down on two main wheels, keep looking as when flattening -out, the control stick being nearly extremely back.

303. Once the nose wheel is in contact with the ground, look ahead and start braking with the automatic braking system by suitably pressing the braking lever so as to complete pressing when at a standstill.

N O T E : 1. The automatic brake system enables the pilot to press its lever extremely back right after the nose wheel has touched down the ground and excludes aircraft crabbing on a dry concrete runway. In this case the braking is rather effective, but requires much air.

2. To avoid overheating the wheels(especially in summer time) start braking procedure at a speed of 200 k.p.h., not more.

304. When it is necessary to brake abruptly(ignoring even damage of tyres) especially in winter or autumn time when the metal plate runway is wet or covered with ice, snow etc) do it with the automatic brake system OFF because it is of little effect.

305. When landing on a small-sized airfield and also in case of high aircraft weight or some error in calculating for landing (e.g. over-shoot) the pilot opens the braking parachute as to cut the length of run or even switches OFF the engines, if necessary. The braking parachute is released right after landing on two main wheels by throwing away its safety cap and pushing the button "Выпуск парашюта" /chute open/. Right after the parachute filling the nose wheel goes energetically down. This done, brake as said above. Landing run being over, taxi aside from the runway and leave the chute by pushing the button "Сброс парашюта" /chute abandon/

Chute opening at a speed of at least 290 k.p.h. results in its break.

306. In case of ballooning the pilot should do the following:

- when floating at an increased speed (nose wheel is up slightly) counteract ballooning at the moment the aircraft is coming OFF the ground, and make two point landing as usual;

- after touching the ground at a normal speed or a little bit below the pilot should keep the stick as it is, banks being put vigorously off by opposite rudder. Then, since approaching the ground make landing on two main wheels by pulling the stick back gently but firmly.

307. In case of high flattening-out(more than 1m.) it is necessary to stop pulling the stick back and, as the speed deminishes and the aircraft is nearing to the ground, make a normal landing on two main wheels.

308. If the main braking system has failed(out of service-wires, a ПУ-7 and ПУ-8 valves,- no air in main balloons) release the brake chute and brake the wheels by impulses using the emergency brake valve.

309. The run being over, cut OFF the nose wheel brake, taxi aside from the landing strip, retract flaps and air brakes (if they have been released) and,if necessary, unpressurize the cockpit and open the canopy (the air supply valve may be left open.

310. After firing flight, taxi away from the landing strip and put the aircraft in the direction safe from the point of view of unloading and cut OFF the engines. No towing is permitted here till the cannons are loaded.

311. МИГ-19Б landing distance is 1700-2180 m., minimum landing run is:

- 890 m with three wheels braked;
- 610 m. with three wheels braked and the brake chute assisted.

Landing With Emergency Stabilizer Electric Control

312. Glide to the flattening-out point at a speed of 330-340 k.p.h. with the gliding angle being shallower than usual.

From the moment of flattening-out up to that of touching down, the stick is pulled back gently and proportionally so that the aircraft would touch down with the stick half way back.

Warning. The degree of stabilizer turning at landing with emergency electric control is 4^0 per second though great efforts are applied to the stick, therefore it is rather difficult to make landing and the pilot should be more attentive at that.

Cross Wind Landing

313. At landing across wind the drift is depressed by opposite side-slipping. It is not difficult to land across a 10 m/sec. wind blowing at 90^0 to the runway. Under stronger wind conditions the drift cannot be eliminated by stick and rudder even aplied fully, because the bank of the side-slipping does not exceed $10-12^0$.

In this case, the pilot should glide at an increased speed of an into-wind engine because under these conditions he is capable of bringing about a little bit more bank.

The drift caused by a violent wind is counteracted by side-slipping and banking into wind at the same time.

At the end of floating just before touching down on two main wheels the aircraft must be straightened, the rudder being put neutral.

Having touched down thus, let the nose wheel get down, this brings about better longitudinal stability, and start braking.

How to Cut Engines on the Ground.

314. The first engine to be cut off is the left one, as the pump of the main hydraulic system controlling the nozzle eyelids of both engines is mounted on the right engine.

The engine is cut off after any speed of it in the following way: open the throttle to 10 000 R.P.M., maintain this power for 1 min. not less and throttle the lever back in the position "Gran" / Stop/.

315. Switch off all circuit breakers but "Насос [illegible] баки" / 1st tank pump/ one. The circuit breakers under the transparent panel are switched off by the aircraft engineer. The rotors of both engines being stopped, put off the buster pump of the 1st tank and storage battery.

316. Put the undercarriage control lever neutral, its latch being brought down.

317. Give instructions to the aircraft engineer [illegible] the operation of engines, controls and equipment in [illegible]

Landing with Emergency Stabilizer Electric

XI. F L I G H T

EMERGENCIES

412. In all cases of aircraft failure the pilot should report to the flight directing officer about the character of the failure and proceed according to the situation and to the flight directing officer's orders.

Warning. The degree of stabilizer turning at landing with emergency electric control is 4° per second through great effort applied to the stick, therefore it is ... difficult ... the pilot should be ... attentive at that.

CASUAL SWITCH-OFF OF ENGINES AND THEIR RELIGHTING IN FLIGHT

... If the engine has casually switched-off at an altitude ... 3000 metres it is necessary to:

... and immediately the engine control lever ... position.

... across wind the aircraft is depressed by ... it is not difficult to land across ... about the axis to the tower.

... up to the runway. Under stronger ... at an altitude of 3000 metres and ... eliminated by stick and ... the bank of the side-slip- ... switch-off at an alti- ... to an altitude ... the engines ... bank ... intersected by ... same time.

... t the end of floating just before touching down on ... two main wheels ... to straighten, the ...

C h a t i o n s: 1. If the speed of autorotation of both engines switched-off casually is less than 3500, ... both generators; if more than 3500 (the generators are coupled not with the circuit, the voltmetre reads 23-26 V) do not switch them off.

How to Cu... 2. Any of the engines ... relight first as the autorotation R.P.M. provide for the pressure in the main hydraulic system sufficient to control the ... cyclids. ... of the main hydraulic system controlling the ... 3. After the failure to relight the engines at the first attempt at an altitude of 3000-2000 metres, switch OFF the APK-5 /gyro compass/, GPK /GPK/ and circuit breakers of ... Vapor 2 ... Vapor 3 ... Vapor 4 ... data/ and tank pump/, ... pump/, the Engine / Siren/, "PB-2"/radio altimeter/, /counter receiver/.

If the aircraft location and meteorological ... allow, the pilot may switch OFF ... Vapor 1 ... heavy, radio compass ... All these mechanisms ... switched ... relight the engines ... came ... of the engines ... happened ... relighting ... the generators ... the overheat ...

414. Try to relight the engines at altitudes of 9000 metres and lower at indicated speeds of not less than 400-450 k.p.h. (speed of autorotation is above 1600 R.P.M.) hereat one should bear in mind that the less the altitude and the more the speed more the reliability of relighting the engines.

415. The engine may be relighted, if necessary, while climbing as well as when gliding.

To relight the engine it is necessary to:

- put the engine control lever in the slow running position, in 2-3sec. open the cover and put on the "Зажигание в воздухе"/Ignition in air/ switch of the engine stopped, hereat the lamp "Запуск в воздухе произведен, /After relighting in air, put off ignition/ Зажигание выключи" will shine, the engine must relight and get slow running conditions;

- the engine relighted, put off the /ignition in air/ "Зажигание в воздухе" switch;

- in 0.5-1 min. after the engine began slowly running, smoothly put the engine in the needed flight conditions.

Cautions: 1. Maximum conditions are allowed to assume in not less than 1 min. after attaining slow running R.P.M.

2. If the gas temperature after relight comes over 750°C, pull the engine control lever backward and set manually the slow running. If it is higher than admitted even after manual correction, put the engine lever in the position "Стоп" /Stop/ and make more gently another relight after a 30-40 sec. engine scavenging. In case of a failure, it is recommended to descend down by 500-1000 metres; next attempt to relight the engine must be repeated not earlier

than in 30-40 sec. necessary to blow the fuel from the engine combustion chambers.

416. If the engines have failed or stalled at an altitude of over 2000 metres, try to relight them one after another at an altitude down to 2000 m. at a normal speed of autorotation(over 1600 R.P.M.) In case of a failure to relight either engine at 2000 m. and over, stop trying and bail out. In case both engines have switched OFF casually at an altitude of over 2000 metres and the speed of autorotation of both engines is lower than 1600 R.P.M. and does not go up with flight speed, do not relight the engines but proceed to a chosen or recommended area by the flight commanding officer and bail out.

417. If one engine is in action but the other would not relight down to 2000m., put the engine control lever in the "Стоп" /Stop/ position, put OFF the engine switch "Зажигание в воздухе" /ignition in air/ and land with one engine.

418. Flight with one engine brings about the torque moment which may be eliminated by applying the pedal, the pilot must avoid great banks to the side of the non-working engine as the aircraft tends to that bank. One should remember that the engine R.P.M. should be higher than usual.

FAILURE OF STABILIZER HYDRAULIC AMPLIFIER

419. A warning lamp checks up pressure in the [illegible] booster hydraulic systems. It glows when the pressure in one of the systems. In this case the pilot [illegible] the pressure by the pressure gauges. If the [illegible] hydraulic amplifier system drops down to [illegible]

main hydraulic system switches on automatically. In case of pressure drop in the main hydraulic system down to 50±5kg/cm^2 the emergency electric stabilizer control will be automatically engaged. It is effected by the electric servo mechanism (ЭСУ - ЭСУ) with the help of the electric tracking АСП-4 device, the stabilizer will be deflected by the control stick as usual.

420. Performing manoeuvres, circuit flights, putting the undercarriage or flaps down on the aircraft directed by the emergency electric stabilizer control have some peculiarities.

These are determined by a low rate of stabilizer deflection (about 4° per sec.) and by the play in the stick when the hydraulic booster is OFF. Because of that the aircraft responds rather slowly to efforts (though great) applied on the stick by the pilot.

The aircraft equipped with the electric servo-mechanizm АСП-4МД have no peculiarities like that.

AILERONS HYDRAULIC AMPLIFIER FAILURE

421. A flight with the ailerons hydraulic amplifier OFF is possible at an indicated speed up to 850 k.p.h.

Efforts on the control stick grow considerably and to fly the aircraft is difficult. These efforts may be put OFF by the trimmer. It enables the pilot to make a long-time flight.

422. If ailerons hydraulic amplifier failed, it is necessary to:

- switch OFF the hydraulic amplifier;
- diminish the speed down to 700-500 k.p.h.
- keep fulfilling the task and land

on the home [illegible]

423. Perform turns with lesser banks and greater [illegible] radii.

Caution: It is forbidden to switch ON the ailerons hydraulic amplifier after it has been switched OFF because of failure.

GENERATORS FAILURE.

424. The failure of both generators in flight can be detected by the red warning lamps glowing and by the reading of the voltmeter; the voltage drops from 28-29 v down to the storage battaries voltage of 23v.

If one of the generators failed the power of the remained one will be sufficient to feed all the aircraft consumers in operation.

425. In case of unsteady parallel work of the generators (a generator lamp blinkers) with voltage not coming over 29 v it is necessary to switch OFF the generator the lamp of which blinkers and if voltage comes over 29 v, that switch OFF the generator the lamp of which does not glow. In case of both lamps blinkering, it is necessary to let the 28-29 v generator operate.

426. In case of failure of both generators under usual or complicated weather conditions switch OFF the following circuit breakers "Насос I-го бака"/1st tank pump/ (at altitudes below 7000 metres), "Насос 2-го бака" /2nd tank pump/, "Насос 3-го бака"/3rd tank pump/, "Насос 4-го бака" /4th tank pump/, "РВ-2, МРП "/radio altimetre, marker receiver/, "Сирена" /siren/ and also switch OFF АРК /radio compass/ and СРО-2 /FFI/ on the control panels.

АРК-5 /radio compass/, СРО-2 /FFI/ and transmitter should be switched ON for a short time, one after another and only in case of necessity.

Caution! If you switch OFF at night the circuit breakers "Радио, АРК, /radio, radio compass/ МРП /marker receiver/, СЦБ /ГПК/, Расходомер/ the fluorescent lamps (УФО) die out and begin glowing again only in 1.5-2 min. Therefore to see better the instruments use the white light.

427. The time of safety flight with the generators failed and the consumers fed by the storage batteries in the above mentioned way is equal to:

- 8 min. if the engines are started by the aircraft storage batteries;
- 12 min. if the engines are started by the ground batteries.

If all the consumers are left "ON", the storage batteries provide ... safety flight for.

- 3 min. if the engines are started by the aircraft storage batteries,
- 7 min. if the engines are started by the ground batteries.

NOTE: The time of safety flight is given for the 12 СКЛ-25 battery which has 75 per cent of nominal storage capacity and + 5°C electrolyte temperature.

The greater the storage capacity and electrolyte temperature, the longer the time of safety flight. In case of failure of both generators the pilot must stop fulfilling the task and land on the home or reserve airfield.

Caution: In case of voltage drop down to 20 v put the [illegible] and flaps down in the emergency way.

Fuel Pressure Drop in Flight.

428. When the fuel pressure drops after the 1st tank pump, the warning lamp "I^{st}_{max}" on the power control panel glows (fig.14) and the engines automatically change maximum or afterburner conditions for nominal ones.

429. If the lamp 1st tank "I^{st}_{max}" glows in high altitude flight, it is necessary to descend and decrease the engines rating till the lamp dies out and does not shine any more.

If the lamp 1st tank "I^{st}_{max}" has died out, adjust the engines speed and go on with your mission, [illegible]

430. With the 1st tank "I^{st}_{max}" lamp glowing it is allowed to continue the flight at an altitude up to 7000 metres under nominal operating conditions not higher.

Oil Pressure Drop in Engine.

431. If the warning lamp "Нет масла /No oil/ has shone in flight, stop fulfilling the task, bring the aircraft into level flight and by a smooth motion of the control lever of the engine failed decrease its R.P.M. till the lamp dies out. If the lamp " Нет масла " /No oil/ does not die out during 15 sec. after the engine control lever was put extremely back switch OFF the engine.

432. If the oil pressure has dropped at near the aircraft ceiling under maximum R.P.M. conditions, moderate the R.P.M. of the engine failed stop down by 2000-2500 m. and then again develop maximum R.P.M.

If the lamp "Нет масла" / No oil/ dies out [illegible] is permitted to fulfill the task at the altitude [illegible] lamp died out.

If the lamp continues to glow with altitude drop, switch OFF the [illegible] engine.

Fig. 14. Inlet fuel pressure drop signalization. (" I[illegible] gas " glows.)

Engine R.P.M. " Suspension "

433. Symptions of the suspension are:

- R.P.M. remain constant even after pushing engine control lever forward to the " Номинал". /Nominal/ position, hereat the engine thrust corresponds to the R.P.M. of " suspension";
- gas temperature does not go up;
- no change in the sound we used to.

C a u t i o n. One should know the R.P.M. "suspension" from the dead zone where revolutions are dead to the engine control lever motions. This zone grows up at altitudes of over 8000-10000 m. when the engine control lever comes out of that zone, the engine R.P.M. and thrust increase.

434. In case of suspension it is necessary to:

- stop fulfilling the task;
- increase the second engine R.P.M. in case of necessity to preserve the flight speed and altitude;
- pull smoothly the engine control lever of the " suspended " engine untill its R.P.M. begin increase;
- try to develop the wanted operating conditions of the engine by a smooth motion of the engine control lever ;
- if the engine R.P.M. do not increase, [illegible] set operating conditions a little lower than [illegible] at beginning of " suspension".

Casual Afterburner Switch-OFF

435. The pilot is aware of a casual afterburner switch-OFF by the thrust drop and checks it by a sharp gas temperature drop.

In case of a casual afterburner switch-OFF put the engine control lever in some lower rating, stop fulfilling the mission, ascend and make landing. Spontaneous afterburner switch-OFF near the aircraft ceiling may lead to the engine overspeed. In this case it is necessary to immediately change for maximum operating conditions when the engine power reaches 11 150 R.P.M. , close up the throttle, descend and land.

If the pilot did not succeed in stopping the overspeed and in 10-12 sec. the R.P.M. did not go down to 11 150, it is necessary to put the engine control lever in the position "Стоп" / Stop/ thus switching OFF both engines or that one which was overspeeded.

Stop fulfill the task,descend,relight the engine and land.

Engine Hunting.

436. Symptons of hunting:

- sudden change in engine work(often flops and shots);
- R.P.M. drop;
- gas temperature growth.

437. Having heard the engines changing their buzzing, the pilot must determine due to the temperature and R.P.M. which of the engines has got into hunting.

If he failed to, he should pull one engine control level backward then the other up to the position " Малый газ" Idle running/.

438. After the hunting engine is determined it is necessary to:

- put the engine control lever at the " Малый газ" Idle running/ position, if hunting is stopped, put gently the engine control lever in the position corresponding to necessary flight conditions but not higher than those of hunting;
- if it is not stopped, switch OFF the engine by putting the engine control lever in the "Стоп" position, this done, relight the engine in the air in the usual procedure, stop fulfilling the task and make landing.

Extra Gas Temperature Under Afterburner Conditions.

439. If gas temperature smoothly grows exceeding the adopted one, it is necessary to bring the aircraft into level flight or descend without switching OFF the afterburner. On the engines with push-button afterburner it is possible in flight below 16 000 metres to decrease gas temperature by closing up the throttle.

If the gas temperature was not reduced down to the permitted one, switch OFF the afterburner. In case of a sharp gas temperature growth stop fulfilling the task and land.

Shaking of Engine.

440. In addition to the instrument panel vibration some change in the usual engine buzzing the symptom

engine shaking are: fluctuation and drop of R.P.M.,gas temperature increase and oil pressure lamp shining.

441. Having felt the engines shaking due to instruments one should find out what particular engine is shaking. If not a success, determine it by putting the engine control levers, one by one, in the "Малый газ" / Idle running/ position.

442. If gas temperature of the failed engine is within the permissible limits and shaking at idle speed has disappeared let the engine control lever stay in the "Малый газ" / Idle speed/ position.

If the engine operating at idle speed goes on shaking or gas temperature overcomes the adopted limits, switch OFF the engine.

C a u t i o n : If you switch OFF the right engine because of its shaking or because of extra gas temperature, bear in mind that the left engine will have a nominal speed not higher, as the nozzle eyelids controlled by the hydraulic system of the right engine will not move.

Fire on Engines.

443. Signs of fire in the zone of the engines are:

- glowing of the red warning lamp " /Fire/ on the left control panel;
- a smoke ribbon after the aircraft tail (it is easy to notice while in turn)

444. To extinguish fire it is necessary to:

- find out which of the engines is in fire ;

- switch OFF this engine by putting its lever in the position " Стоп"" / Stop/;
- press the engine push-button "Перекрывной кран"" /Distributing valve/ , - press the "Огнетушитель" push-button and stop fulfilling the task.

If the pilot does not know what engine is in fire, it is necessary to:

- switch OFF both engines by putting the engine control levers in the "Стоп" /Stop/ position;
- switch OFF circuit breakers (АЗС) of the fuel booster and displacing pumps " Насос 1го бака" / 1st tank pump/, " Насос 2го бака"/2nd tank pump/,"Насос 3го бака"/ 3rd tank pump/, " Насос 4го бака"/4th tank pump/;
- press the push-buttons of the close-cock "Перекрывной кран" of both engines;
- reduce aircraft speed down to 350-400 k.p.h. by bringing the aircraft into climbing;
- press the fire extinguisher push-button " Огнетушитель"
- do not relight the engines, go to a chosen area or area pointed out by the flight directing officer and bail out.

C a u t i o n : To relight engines after extinguishing fire is F O R B I D D E N.

Smoke in the Cockpit.

449. When smoke or unusual smell penetrates into the cockpit, it is necessary to:

- put the air suction cock on the [illegible] (DY-2) panel in the position "100% O_2";

- step down to 12000 m and close the air supply cock;

- if the smoke has not stopped getting in, descend down to 10000 -11000 m and unseal the cockpit;

- if the smoke does not get out, drop away the canopy by means of " Аварийный сброс фонаря" /emergency canopy drop/ handle.

446. The canopy drop over the fin is safe in level flight at indicated speeds of 400-700 k.p.h. The best condition for dropping the canopy in such a way is level flight at an indicated speed of 600 k.p.h. at an altitude of not below 500 metres.

C a u t i o n : To provide safety drop of the canopy it is F O R B I D D E N to open it in flight.

Automatic Air Supply Failure.

447. If the failure of the automatic air feeding system causes a high temperature, put the electric selector switch in the position "Холодный" / Cold /. If in this case it runs high for over 40 sec., reduce the air supply to the cockpit by closing up slightly the manual air supply cock and, when necessary, unseal the cockpit and descend to a safety altitude.

Icing of Aircraft.

448. In case of aircraft and its canopy icing while penetrating up through clouds switch ON the de-icing system when in level flight about them. Switch it ON by 3-5 sec. impulses with 10-15 sec. intervals. If aircraft icing took place while penetrating through clouds downward,

do not change that mode of flight; use the canopy de-icing system from an altitude of 1000 metres.

449. The most favourable conditions for the aircraft to have the ice removed are through entering its speed, if opportunities offer, up to 700 k.p.h. on the instrument (at middle altitudes) and up to a true speed of 800 k.p.h. (at high altitudes).

While descending under weather conditions favourable for icing the operation of the engines at a number of R.P.M. below 9000 must be as short as possible so as to avoid icing of the engines and canopy too.

Canopy Jamming on Landing.

450. If the pilot has to immediately leave the cockpit on landing (in case of fire etc) but the canopy has got wedged, drop it away in the emergency way by the " Аварийный сброс фонаря" / Canopy emergency drop/.

Pitot Tube Failure.

451. If the speed and Mach indicators and the АРУ-2 read wrong it is necessary to switch over the supply switch on the left control panel from the main Pitot tube onto the emergency ПВД-156 , stop fulfilling the task and land.

452. In case all the instruments ЛУС-2000, М-17, БД-20, ВАР-300, УПВД-15 and АРУ-2 simultaneously fail or read wrong and also in case there was positive result after overswitching from the main Pitot tube onto the emergency ПВД-156 one should stop fulfilling the task and land using the artificial horizon and the engines [illegible] indicators.

Before the landing approach put the АРУ-2 switch into the position " Ручное"/Manual/ and by the arm-switch put the АРУ-2 in the "Большое плечо" / Great arm / position.

Failure of Oxygen System.

453. Symptoms of oxygen system failure:

- a sharp oxygen pressure drop in the system (by the oxygen pressure gauge МК-18);

- stop of oxygen supply to the mask (the motionless segments of the ИК-18 indicator point out to an " altitude " in the cockpit below 11 000-13 000 metres that is before the КП-30 (КП-34) of continuous oxygen МК-18 supply is switched ON);

- the cockpit being unsealed at altitudes above 12 000 metres (oxygen continuous supply from the board device being on), no surplus pressure is produced in the pressure suit chambers and mask (the pressure gauge М-1000 reads no pressure).

454. If any of these symptoms has taken place, immediately switch ON the parachute oxygen device КП-27М. After that, descend down to an altitude where one can get along without oxygen feeding and stop fulfilling the task.

Note : To preclude oxygen escape from the device into the cockpit while flying at altitudes of 4-12 km. it is necessary before switching OFF the parachute device КП-27 М to put the handle of the ДУ-2 (ДУ-1) mechanism in the "Выкл. костюма"/ Suit switch / position.

Unsealing of the Cockpit at High Altitudes.

455. In all cases of aircraft unsealing, reduce the flight altitude.

456. If the cockpit was unsealed because of canopy glass destruction or because it was torn away, immediately and as quick as possible descend down to a safety altitude and decrease the speed. Stop fulfilling the task and land.

Emergency Extension of Undercarriage and Flaps.

457. If it is impossible to release undercarriage in the usual way (no pressure in the main hydraulic system), release it in the emergency way for which:

- put the undercarriage cock into the neutral position;

- vigorously pull out the bracket of the emergency unlocking of the undercarriage and let the bracket free in 1-2 sec.;

- check whether the undercarriage legs unlocked (the warning lamps die out, pop-up indicators will somewhat go out);

- put the undercarriage cock in the " Выпущено" / Down/ position;

- open the undercarriage emergency air balloon cock on the right control pannel;

- check by the warning lamps and pop-up indicators that the undercarriage is extended and its legs are locked;

- close the emergency undercarriage cock when flight is over and engines are OFF.

458. For an emergency release of flaps it is necessary to:

- press the button "Посадка" /Landing/ which is on the flaps panel;
- open the emergency air balloon on the right control panel;
- check up the flaps release by the glow of the "Закрылки выпущены" /Flaps down/ warning lamp on the flaps control panel and on the landing board;
- close the flaps emergency cock after flight is over and engines are OFF.

Destruction of Wheel Pneumatics or Fire Protectors.

459. While taking off with the maximum flying weight under unfavourable weather conditions (high temperature, low barometric pressure, tail wind) which make the take-off speed higher and also in case of a bad runway the wheel pneumatics and tire protectors may be damaged.

Wheel pneumatics being damaged or tire protectors being torn away, the wheel dynamic balance may be upset and cause shaking of the aircraft and torque moment.

If the aircraft is shaking after take-off the pilot must brake the wheels immediately after coming off the ground. If the shaking has stopped, it means it was caused by wheels destruction.

Before landing with damaged wheels it is necessary to:

- reduce the landing weight as much as possible by consuming fuel and dropping the suspended tanks with fuel;
- in summer time use the ground runway but not the main runway especially when the latter is covered

with metalic plates;
- be more careful and make an accurate calculation while approaching in for landing;
- perform landing down at a speed as minimum as possible;
- release the braking parachute at the moment of touching the ground;
- brake smoothly all the wheels, the automatic braking system being switched OFF (pressure in the brakes should not exceed 4-5 kg.p. cm^2).

N O T E : If it is necessary to shorten the running length the pilot may use full braking.

Pilot's Actions in Forced Landing.

460. It is the pilot who decides to perform a forced landing outside the airfield. To land with retracted or lowered undercarriage depends on the terrain beneath.

461. While forced landing with lowered undercarriage the pilot must:

- report to the flight directing officer about the field to land on;
- drop the suspended tanks if there is some fuel there;
- drop the blocks of ORO-57 k with the [redacted];
- lower the undercarriage and flaps;
- drop away the canopy at an altitude of above 500 metres, lock the safety belts and land in the usual way;
- after touching the ground switch OFF the engines, release the braking parachute and then switch OFF the storage batteries.

462. While braking take into consideration the ground density and presence of obstacles.

463. A forced landing with retracted undercarriage should be performed only on the ground. The pilot's actions procedure remainsthe same as with undercarriage down.

Caution: If the pilot is not sure of landing he must get better conditions (speed, altitude,power) for bailing out and leave the airplane.

464. When forced landing on the enemy's territory the pilot is obliged to explode the receiver-transmetter of the aircraft responder SRO. After landing do your best to destroy the aircraft.

Pilot's Actions while Bailing Out

465. To leave the aircraft by means of the ejection seat it is necessary to:

- bring the aircraft, if possible, into level flight and decrease speed.

NOTE: In an emergency case at an altitude below 500 metres it is advisable, before bailing out, to gain a maximum possible height using speed and engine;

- press yourself tightly against the seat back and tighten the safety belts;

- take the feet off the pedals and put them on the seat step;

- press the back of the head to the head cushion,take a firm stand on the step,grip the shield handle and vigorously pull it down over the face, thereat the elbows must be pressed to the body to save them while being shot out of the cockpit.

Note: Jettisonning of the canopy takes place at the moment when the shield crosses the eye level. While canopy jettisonning, the shooting mechanism is unlocked. The shield handle crossing the chin level the seat is ejected.

Caution: If no shot occurs when pulling down of the shield (no canopy jettisonning follows), it is necessary to throw the canopy by the "Аварийный сброс фонаря" Emergency canopy drop/ handle. The handle being turned, the shooting mechanism will be unlocked for sure. If the canopy is jettisonned, bail out by means of the seat arm trigger. If the canopy is not jettisonned, bail out by means of the shield. When the "Аварийный сброс фонаря" /Emergency canopy drop/ handle is turned, the ejection seat gets unlocked and it is possible to bail out through the canopy. In all cases before jettisonning, the canopy must be closed.

466. After bailing out it is necessary:

- in 1.5 sec. make it sure that the safety-belts are unlocked by the AD-3 device and push vigorously away from the seat with hands and feet;

- if the safety belts were not unlocked by the AD-3 device, unlock them in 1.5-2 sec. after ejecting by pulling out the ring on the right belt and get out of the seat;

- continue falling until the parachute is opened.

467. Bailing out at altitudes below 500 metres immediately after getting out of the seat open the parachute by pulling out the rip cord.

468. After bailing out at an altitude above 500 metres (up to the practical aircraft ceiling) continue falling until the KAП-3 device opens the parachute at an altitude set on the device or in 2 sec. after the pilot has left the seat, if he bailed out at an altitude lower than set on the device.

If the KAП-3 device does not open the parachute, open it by pulling out the rip cord at an altitude above 500 metres.

469. If it is necessary to open the parachute at an altitude higher than that set on the KПП-3 device (because of intensive twirling, or ear pain, or bailing out over high mountain terrain) one may open the parachute in 5 sec. per 1000 m. after separation from the seat (Table 8).

470. When bailing out at altitudes above 9000 metres open the parachute only after 10 sec. delay for each 1000 metres (Table 8)

T A B L E 8.

Flight altitude when bailing out, in metres.	10 000	11 000	12 000	13 000	14 000	15 000	16 000	17 000	18 000
Necessary delay in parachute opening, in seconds.	10	20	30	40	50	60	70	80	90

471. Having bailed out over the ground which is not seen (at night, in clouds), open the parachute manually according to the instructions given in paragraphs 467,459,470.

472. When you leave the aircraft at an altitude above 12 000 metres from the unsealed cockpit, remember that adoption of an attitude of readiness (to put feet on the seat step and to raise hands for pulling down the shield) requires from the pilot some additional efforts as the hoses and chambers of the pressure suit are filled with oxygen. But bailing out itself has no other peculiarities.

N O T E : It is the pilot who having put on the anti-G suit with all its high altitude equipment trains himself on the aircraft (under the supervision the unit doctor and instrument specialist) in assuming ready - for - bailing -out attitude.